TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

NINETEEN HUNDRED SEVEN

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

Thirty-sixth Annual Meeting

JULY 23, 24 AND 25, 1907,

At Erie, Pennsylvania.

APPLETON, WIS.
THE POST PUBLISHING COMPANY, PRINTERS AND BINDERS
1907

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AMERICAN FISHERIES SOCIETY

Organized December, 1870.

PRESIDENTS.

1.	William Clift	1870-1871
2.	William Clift	1871-1872
3.	William Clift	1872-1873
4.	Robert B. Roosevelt	1873-1874
5.	Robert B. Roosevelt	1874-1875
6.	Robert B. Roosevelt	1875-1876
7.	Robert B. Roosevelt	1876-1877
8.	Robert B. Roosevelt	1877-1878
9.	Robert B. Roosevelt	1878-1879
10.	Robert B. Roosevelt	1879-1880
11.	Robert B. Roosevelt	1880-1881
12.	Robert B. Roosevelt	1881-1882
13.	George Shepard Page	1882-1883
14.	James Benkard	1883-1884
15.	Theodore Lyman	1884-1885
16.	Marshall McDonald	1885-1886
17.	W. M. Hudson	1886-1887
18.	William L. May	1887-1888
19.	John H. Bissell	1888-1889
20.	Eugene G. Blackford	1889-1890
21.	Eugene G. Blackford	1890-1891
22.	James A. Henshall	1891-1892
23.	Herschel Whitaker	1892-1893
24.	Henry C. Ford	1893-1894
25.	William L. May	1894-1895
26.	L. D. Huntington	1895-1896
27.	Herschel Whitaker	1896-1897
28.	William L. May	1897-1898
29.	George F. Peabody	1898-1899
30.	John W. Titcomb	1899-1900
31.	F. B. Dickerson	1900-1901
32.	E. E. Bryant	1901-1902
33.	George M. Bowers	1902-1903
34.	Frank N. Clark	1903-1904
35.	Henry T. Root	1904-1905
36.	C. D. Joslyn	1905-1906
37.	E. A. Birge	1906-1907
38.	H. M. Smith	1907-1908

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PART I.

BUSINESS SESSIONS

Transactions of the American Fisheries Society.

Tuesday, July 23, 1907.

Convention called to order at 12 m. by the Secretary, Mr. George F. Peabody, of Appleton, Wisconsin, at the Chamber of Commerce, in the Reed Hotel building, Erie, Penn.

The following program was presented:—

"*The Cultivation of Fishes in Small Ponds*," CHARLES H. TOWNSEND, New York Aquarium, Battery Park, N. Y.

"*Planting Fish, versus Fry*," JOHN L. LEARY, U. S. Bureau of Fisheries, San Marcos, Texas.

"*Some Observations on European Fisheries and Fish Culture*," DR. H. M. SMITH, U. S. Bureau of Fisheries, Washington, D. C.

"*The Respiration of a Lake*," EDWARD A. BIRGE, College of Letters and Science, Madison, Wis.

"*The Shad Work on the Delaware River for* 1907 *and Its Lessons*," W. E. MEEHAN, Commissioner of Fisheries, Harrisburg, Pa.

"*Recent Progress in Artificial Propagation of Lobsters*," PROF. A. D. MEAD, Brown University, Providence, R. I.

"*Experiments in Raising Black Bass by Taking the Nests Away from the Parents and Hatching the Eggs in Troughs*," EDWARD A. BIRGE, College of Letters and Science, Madison, Wis.

"*Progress in Fish Culture During the Past Year*," JOHN W. TITCOMB, U. S. Bureau of Fisheries, Washington, D. C.

"*The Influence of Politics Upon the Work of the Fish Culturist and How Fish and Game Protective Associations May Assist the Latter*," A. KELLY EVANS, Toronto, Canada.

"*The Need of an International Fisheries Society*," O. T. OLSEN, Grimsby, England.

"*The Protection of the Alaska Salmon Fisheries*," PROF. BARTON W. EVERMANN, U. S. Bureau of Fisheries, Washington, D. C.

"*The International Problem of the Proper Regulation of the Fisheries of the Great Lakes*," A. KELLY EVANS, Toronto, Canada.

"*Time of Spawning of Rainbow Trout, and the Varieties of this Species*," C. RAVERET-WATTEL, Director of Pisiculture, Dept. of Seine, Paris, France.

"*The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries*," G. W. FIELD, Chairman Massachusetts State Fish Commission, Boston, Mass.

"*The Necessity of the State Making Laws for the Protection of Food Fishes After Stocking Waters by the State or United States*," OREGON MILTON DENNIS, Secretary Maryland State Game and Fish Protective Association.

"*Manipulation of Salmon Eggs*," CHARLES G. ATKINS, East Orland, Me.

"*Notes on a New Hatching Jar*," FRANK N. CLARK, Northville, Mich.

Secretary Peabody: In the absence of the President, it is proper to elect a temporary chairman, which will be the first order of business. I am requested by the committee representing the chamber of commerce, to say that a souvenir is to be given to each member, and they are asked to use the badge that is included in the envelope.

Motion made and seconded nominating as temporary chairman Mr. Frank N. Clark, of Northville, Michigan.

Motion put to a vote and unanimously carried.

Mr. Frank N. Clark: Gentlemen of the American Fisheries Society: I can assure you I am very sorry our honored president is not here, but undoubtedly there will be nothing to come up at this meeting, while the temporary chairman presides, except simply to organize. What is the pleasure of the society? We will, of course not take up really our general order of business, and, as our Secretary has called the meeting to order, it is not necessary for the acting president to do so. There is present a reception committee of the chamber of commerce of the city of Erie, where we are now meeting, and we will be pleased to hear from the chairman of that reception committee.

Mr. Hamberger, chairman of the reception committee: Mr. President and Gentlemen of the American Fisheries Society: As chairman of this committee, there devolves upon me the pleasure and honor of introducing to you the former mayor of the city of Erie, the Hon. Frank A. Mizener, who will speak to you. I have the pleasure of introducing Mr. Mizener.

Mr. Frank A. Mizener: Gentlemen: As a rule I do not make apologies, but I consider that this body certainly is deserving of an apology for my presence here to-day, because you expected our honored mayor to give you an address of welcome. Unfortunately, he was called out of town, and last night about midnight my telephone rang, and the mayor and my friend Mr. Ham-

berger asked and insisted that I take his place here and welcome you to our city, which I do, with a great deal of pleasure. I hope you will be as charitable and nice as certain miners were out in the west, when one of their fellows died, and they discussed among themselves what sort of an epitaph they should put on his tombstone. They argued for some time, and finally one fellow said:—"I tell you, put on there: 'He done his damndest, angels could do no more.'" (Laughter and applause.)

I am very sorry the mayor is not here, because he is thoroughly acquainted with your interests, and I am not, and besides he is a great fisher of men. As a vote-getter there is no better man that I know of in the city of Erie. And he is a good fisherman, and I am sorry on that account that he is not here. I know nothing about fishing, not even about fishing for men, but our friend Senator Sisson is thoroughly conversant with that sort of business, and he no doubt will entertain you on that subject. But I do want you strangers to know a little about the city of Erie, and before you go away no doubt you will know more about it.

We consider that we have the gem city of the lakes, one of the most beautiful cities in this country anywhere. We have a population of close to 70,000 people, and no stranger ever came here to visit and went away that was not very anxious to come back again to our city. We consider that we are very hospitable. We sort of bank on that. We try to make every stranger who comes here feel at home. While we have quite a large city, yet everybody here almost knows everybody else. It is that sort of a town. We have here the largest boiler establishment in the world. Now, that sounds large, doesn't it; but it is the absolute truth; and we make more boilers and engines in the city of Erie than any one city in this country. Our industries are varied. We have blast furnaces, large paper mills, and all varieties of industries that have built up our city, and I want to say this to you, that I do not know of any city in this country, and I doubt if there is one, where the mechanics and the laboring men of the city own as many of their homes as they do in Erie. That is what makes it a good city, because the people own their own homes and they are interested directly in every bit of taxation

and every public work that goes on, and in every election that is the question that is brought up, and these men talk about it intelligently, and they are interested because of their pocketbook being affected, if the rate goes up or the rate goes down.

Now, gentlemen, I am authorized by the mayor to extend to you the hospitality and the freedom of this city. The gates are wide open, and we trust that you will have as good a time as you have ever had at any place that you have met. You have our best wishes, and anything we can do to further your interests and your pleasure we are only too glad to do.

I thank you, gentlemen, for your attention.

(Great applause.)

Mr. Hamberger: Mr. President, it was the aim of this committee to have the governor of the state of Pennsylvania present at this convention, but a previous engagement kept him away. However, we have with us to-day the second highest official of the state of Pennsylvania in the person of the President of the Senate, Senator E. A. Sisson, and I take great pleasure in introducing him to you. He will extend to you the welcome of the state. (Applause.)

Senator E. A. Sisson: Mr. Chairman, and Gentlemen of the American Fisheries Society: Not the second highest officer. We have a lieutenant-governor here. (Laughter.) To being president pro tem. of the senate I will plead guilty. The governor of the commonwealth, realizing the importance to the people of the United States of this industry for which you gentlemen speak, would have been very glad to be with you to-day, and he regretted exceedingly his inability to be here and to express to you his appreciation of the industry you represent and of the possibilities that lie at its door. I was requested at a late hour this morning to say a few words to impress upon you the fact that we are very glad that you are here, and that the whole commonwealth appreciates the honor you pay the state in coming within its borders to deliberate upon the questions involved in this industry.

I represent in the senate a district that is interested in the fishing industries of the state and nation, and, as such, I, too, have come to realize the importance of this industry to the people

of the nation. We all are growing more and more in recent times to see the possibilities that lie in the intelligent handling and management of the fishing industries of the nation. We, here at Erie, while we have but a very short lake frontage have come by practical experience to realize and appreciate an intelligent management of the fishing industries of the commonwealth, to say nothing about the industries of the nation. A few years ago the fishing industry here was at a very low ebb, and our fishermen could get very few of the food fish for which they searched; but Commissioner Meehan, backed up by the commonwealth, and more or less assisted by the people of the adjoining states, has attempted to stock the lake, and they have been using intelligent efforts in that direction, and accompanying those efforts we see and feel the impulse that it has given to the fishing industry, and our fishermen now come in with good hauls where before the catches were very light.

This is a subject for thought and for consideration. Therefore, in seeing what has been done here in this very short time, as we look over the waters of the state and nation and as we consider the very great and very important food to the people of the nation that is produced by the intelligent handling of the fisheries and the fishing industries, we increase our appreciation of the importance of an intelligent management and handling of the opportunities at our doors.

And so we greet you here very gladly. We appreciate the importance of your consideration, the great values,—increased values—from this source which have come to mankind from an intelligent consideration of this subject by just such men as you who are giving it thought and consideration, who have experience and opportunities, and therefore can give great impetus and great value to this industry which, in a large measure, has been neglected in years gone by, and to restock our waters, state and nation, and to supply this very important article of food to the people of the nation, is certainly a very important question. It is in its infancy, and this association is happily conceived, happily formed, and we trust that prosperity and gratification will accompany you in your efforts in this line. While we have a limited lake frontage and Philadelphia is our ocean port, of course the shad industries of the Delaware are important to us.

I don't know how many of you gentlemen are interested in that character of industry, but I presume they take it all in, don't they, Mr. Meehan?

Mr. Meehan: Yes.

Senator Sisson: We, of course, are chiefly interested in the fresh water fisheries, and in Mr. Meehan's success. We have had some questions that have shaken us up a little here. We are willing to co-operate for the best end of all, and the question of an open or a closed season upon our waters here has affected us. We realize that the fish run from one jurisdiction to another, and that the state of Pennsylvania cannot operate alone in benefiting this industry of fishing in the lake any more than Ohio or New York state can. But it is certain that the best management that can come for this very large industry upon these waters, requires that all of the states, as well as Canada, bordering upon these waters, must act together. It will not do to close at one place and open in another. It is impossible. The law should be uniform, if possible, and if you gentlemen can aid in bringing about that condition, you will have accomplished a great end. We are trying to unite with New York state, with Delaware, with Maryland, and with New Jersey, in securing regulation relative to fishing in the Delaware and Susquehanna rivers, and it is a much larger proposition of concurrent legislation than I apprehend is this industry in Lake Erie. I trust you gentlemen may be able to work out something to that end. We had a close season here, but with New York fishing, and open laws in Ohio, it would not work. It was imposing, I think, on our people here; it would not work out. They have got to work uniformly. And I tell you—the New York gentlemen—I don't know whether any of them are here to-day—but the commissioner from New York state, Mr. Whipple, of the town where your last governor came from, and Senator Alls, and two or three other gentlemen, met with our commission,—a commission of which I then was a member—for the purpose of securing legislation relative to fishing in the Delaware. The New Jersey people were there also. We had a close season. I told those people that our people had tied up their boats and taken their nets out of the water and had stopped fishing, but they looked down to Dunkirk and those New

York ports, and they were fishing there still. And I said, you can't expect us to abide by that unless you secure legislation that will give you the same close season that we have here. We cannot stick to that—the same waters, same fish—and they thought that they would get legislation; that they would have a close season on the waters of Lake Erie; but when the next following season came around they were fishing there—no such laws at all. And I will say for Mr. Meehan, because I presume most of you come in touch at different times, that he was very anxious to secure uniformity, and have Pennsylvania do her full share in bringing it about, and a little more. But we impressed him with the idea that we would not stand for it here, and I was right after him, and he had to give in. He is anxious to have the best here that is possible for Erie, but I thought he had done his full share for the state in trying to secure that end, and he had a turbulent lot of fellows up here to deal with—myself one of them, you know (laughter), and so we have the close season again. I trust, gentlemen, you may accomplish something in this line of uniformity in legislation. I thank you for your attention. (Applause.)

President pro tem.: Gentlemen of the Association, I presume many of you noticed a change in my countenance as I was sitting here, about three or four or five minutes ago. There certainly was, I felt it. While the mayor and president of the senate were giving us such a hearty welcome, I was thinking, after viewing this program here, what I was going to do, and after such a hearty welcome I did not know what I was going to give you in response. But now, as you all know, I am very glad to escort our honored president to his chair. (Applause.)

Prof. E. A. Birge, President of the Association, was escorted to the chair by Mr. Clark.

President: I think this is taking a rather mean advantage. It is not the first time that Erie has taken advantage of me, for I find that the sun gets up an hour earlier here than the railroad, and, while I had expected to get in here an hour before the time scheduled for the meeting, I find I am a few minutes late.

I greatly regret, sir, that I was not present when you were

giving us the words of welcome; because I could respond to them more readily if I had heard them, but I thank you for the words that you have spoken, and I am sure that the American Fisheries Society will greatly enjoy the meeting here, and will find it profitable.

The subject on which you were speaking as I came in, that of close season legislation for the great lakes, is one of very great importance and one of very great difficulty. I see no way to secure satisfactory results except by national legislation on the subject. We have talked concurrent legislation on the part of the states, and, in some minor particulars, we have been able to secure it. During the past winter, for example, the states of Wisconsin and Minnesota have agreed on similar legislation for the Mississippi river. It is a great step in advance, although by no means affecting so great an industry as, but an incomparably smaller industry, indeed, than that of the great lakes.

But the subject of legislation for the great lakes, involving, as it does, so many states and so many and diverse interests, is one which I believe can be handled successfully only through the national government, and I believe that the way to secure results is for the states to join in requesting legislation from the national government and to have that legislation directed and controlled by the national commissioner of fisheries, acting with the advice of the officers of the various states. Because there is no one system of laws which can be enacted that will apply fairly and justly to the different states, stretching, as the lakes do from Lake Ontario on the east to Lake Superior on the west, extending over a very great range north and south, with varying temperature of the water, and different breeding habits on the part of the same fish, different species of fish having different places in the economics of the different stations. For these reasons it is not possible to enact any one code of laws which shall operate fairly and justly, even over the limits of a single state. In Wisconsin, for instance, if we enact any single law applying to the state of Wisconsin, and make it extend from the southern line of the state on Lake Michigan to the northern limits on Lake Superior, we find that it fits one portion of the lakes, and does not fit the other. And, therefore, the problem of securing a rational law for the close season is one of considerable difficulty, and one

which can only be handled by the national government. I trust that the deliberations of the national society will further the interests we represent.

I thank you again for your words of greeting. (Applause.)

President: The next order of business upon our program, is the address by Mr. Meehan, in behalf of the state. (Applause.)

Mr. Meehan: Mr. Chairman and gentlemen: The duty of welcoming you on behalf of the state has been performed admirably by my friend Senator Sisson, president pro tem. of the senate. My name was placed upon the little program by the chamber of commerce here, because it was supposed that Senator Sisson, who is busy investigating the capitol, would not be here. But fortunately for us, he was present and able to do this, and, therefore, I can only simply join with Senator Sisson in giving you a hearty welcome to the commonwealth of Pennsylvania, and hoping that you will have a very enjoyable time while you are here.

I know that the reception committee of the city of Erie will do all they can to make your time pleasant, and I also desire to extend to you a welcome, on behalf of the state, and also to extend an invitation to you to visit any of the state hatcheries when your time will permit you to do so, either during the sessions, or afterwards. Should any of you desire to visit any specific hatchery in this state, if you will let me know, I will arrange that some one—either myself or some one else—will take you there and show you everything that is to be seen.

We have three hatcheries in this county, one here in the city of Erie, that is not in operation at the present time, as it is for the propagation simply of lake fishes; one about twenty-five or twenty-six miles below, an auxiliary, where they propagate some bass, a new station, but at the present time there are quite a lot of small bass there; and the Corry hatchery, of which you have all heard. The Crawford hatchery, which is a new station and only just started, would only interest those of you who would like to see things as they are started. But we have some others, and wherever you would like to go we will find some one to take you there and show you everything we have to show and tell you everything you want to know.

Pennsylvania is especially interested in having you here, because Pennsylvania is especially interested in having any one come into Pennsylvania for any purpose whatever, and, secondly, because we are especially interested in the propagation of fish. Pennsylvania was one of the very first to engage in that great work, as early as 1867, and it has steadily worked and tried to keep prominently in the work, and it is considered so important to-day that the legislature of the state has made a department of it and established a cabinet position as the head of it, and we are trying to do good work, and we think we are doing successful work. We are trying to learn all we can, and if there is anything that we can teach you, we are glad to do it.

Gentlemen, I welcome you again on behalf of the state. (Applause.)

President: I express the thanks of the society for your kind words of welcome. We are glad to meet in Pennsylvania. We know the record of the state in the matter of the propagation of fish, and we know that you were one of the first states to engage in the work forty years ago. It is a long time. The propagation of fish is a very different thing to-day from what it was in 1867, when the state of Pennsylvania first took it up. And to Pennsylvania, perhaps as much as to any of the states of the union, is due the position which that industry holds in the commonwealths of this country to-day.

I thank you for your words of welcome. (Applause.)

President: I believe the next thing on the program is to adjourn for lunch, unless there is some other business.

Mr. Frank N. Clark: Mr. President, I do not think it provides in our general order of business for the President to appoint a committee on program. If it does not, I think we should have such a committee. Of course I understand the local reception committee have a program, but you will call to mind that we always have to have our own program committee to arrange how the papers shall be taken up. I think that committee should be appointed before we adjourn, because we have business to do as well as pleasure.

President: I will appoint on this committee Mr. Frank N.

Clark, Mr. Henry E. Root, and the secretary, Mr. George F. Peabody, as the program committee.

Is there any other business to be transacted this morning?

Mr. Clark: I would like to say, if there are any papers that Mr. Peabody has not a list of, the committee should know what they are and what they have reference to so that we may be able to arrange a program. So if any one has any papers that they are going to present, that Mr. Peabody has not received, just give them to him, and then we can arrange our program so that it will be ready for the afternoon session.

Secretary Peabody: It is also customary for the members to give their names to the stenographer, as a sort of enrollment, instead of calling the roll. We have four or five hundred members. It is rather unnecessary to call the entire list of names, and if those present will simply give their names to the stenographer, that records them as present.

Mr. Clark: Another thing: Mr. President, any names of new members ought to be handed in, I think, right now.

President: If there are any names, hand them in in writing.

Mr. A. C. Roberts: I will state that I have some cards that we use for that purpose, for candidates for membership, and if any members have names they wish to present I would like to have the names for membership presented on those cards.

Mr. Meehan: Before we take the recess, Mr. Hinrichs, the chairman of the reception committee, would like to speak a moment to the members.

Mr. Hinrichs: Mr. President, and gentlemen: I just wish to call your attention to the program that has been mapped out for the members of this association. At 7 o'clock this evening there will be several cars in front of the Reed House, which will take the members up to Waldemere Park, four miles west of here. It is a beautiful spot, and I know you will all enjoy yourselves there and appreciate the scenery. To-morrow morning at 7:30 sharp, there will be boats at the public dock, foot of State street, which will take all those that wish to go out onto the fishing

grounds. They will have an opportunity of seeing how the nets are set and lifted and how the fish are procured at this port. The trip will occupy probably three hours, may be three hours and a half. We leave at 7:30 sharp, and all are asked to be present, because the facilities are sufficient to take all the delegates.

Then the later part of the program you will find on the little cards which are in the envelopes, and if any changes are made we will notify the secretary of the association and he will kindly announce them at the meetings.

President: We stand adjourned to 2 o'clock, local time.

AFTERNOON SESSION.

July 23, 2 p. m. Meeting called to order by the president.

The registered attendance at the meeting of the society is as follows:

Bean, Tarleton H., *New York City.*
Berkhaus, J. R., *Hahnasburg, Phila.*
Birge, Prof. E. A., *Madison, Wis.*
Bower, Seymour, *Detroit, Mich.*
Bower, Ward T., *Northville, Mich.*
Buller, Nathan R., *Pleasant Mount, Penna.*
Buller, H. M., *Bellefonte, Pa.*
Buller, A. G., *Union City, Pa.*
Brooks, Chas. F., *Sandy Springs, Md.*

Carter, E. N., *St. Johnsbury, Vt.*
Clark, Frank N., *Northville, Mich.*
Crampton, John M., *New Haven, Conn.*

Downing, S. W., *Put-in-Bay, Ohio.*

Evans, A. Kelly, *Toronto, Canada.*
Evans, Barton D., *Harrisburg, Pa.*

Filkins, B. G., *Northville, Mich.*
Fullerton, Samuel F., *St. Paul, Minn.*

Geer, E. Hart, *Hadlyme, Conn.*
Green, Chester K., *Cape Vincent, N. Y.*
Grill, J. B., *Sherburn, Minn.*

Haas, Wm. F., *Spruce Creek, Pa.*
Hartman, Phil. H., *Erie, Pa.*
Jennings, G. E., *New York City.*
Leach, Glen C., *Put-in-Bay, Ohio.*
Lydell, Dwight, *Comstock Park, Mich.*
Mathewson, George T., *Enfield, Conn.*
Mead, A. D., *Providence, R. I.*
Meehan, W. E., *Philadelphia, Pa.*
Miller, Frank, *Put-in-Bay, Ohio.*
Morton, Wm. P., *Providence, R. I.*
Peabody, Geo. F., *Appleton, Wis.*
Roberts, A. D., *Woonsocket, R. I.*
Root, Henry T., *Providence, R. I.*
Safford, W. H., *Conneaut Lake, Pa.*
Smith, Dr. H. M., *Washington, D. C.*
Thayer, W. W., *Detroit, Mich.*
Titcomb, John W., *Washington, D. C.*
Townsend, C. H., *New York City.*
Webster, B. O., *Bellefonte, Pa.*
Whitaker, Andrew R., *Phoenixville, Pa.*
Willard, C. W., *Westerly, R. I.*
Wires, S. P., *Duluth, Minn.*

President: The first matter on the program is the report of the Secretary.

Secretary: Mr. Chairman and gentlemen, the report of the Secretary is printed, and I believe is in the hands of every member of the society, and there is nothing further to add to that report.

Mr. C. W. Willard: Mr. President, I would suggest, before going on any further with business, that those names which have been presented for membership be admitted to membership, so that they may participate in the meeting as members.

The following list of new members was, on motion duly made, seconded and unanimously admitted to membership.

Brush, Dr. H. L., *Conneaut Lake, Pa.*
Burnham, C. W., *Washington, D. C.*

Casperson, Bjorn, *Yes Bay, via Ketchikan, Alaska.*
Casperson, Thorgrin, *Yes Bay, via Ketchikan, Alaska.*
Catte, Eugene, *Langdon, Kan.*
Crampton, John M., *New Haven, Conn.*

Darrow, Charles E., *Conneaut Lake, Pa.*
Dominy, Jeremiah M., *South Haven, L. I.* (Life.)

Field, Dr. Geo. W., *Mass. Fish Com., Boston, Mass.*

Hancox, W. K., *Yes Bay, via Ketchikan, Alaska.*
Hanna, Robert, *Fergus Falls, Minn.*
Hanson, Louis H., *Yes Bay, via Ketchikan, Alaska.*
Humy, Gaston H. D., *Yes Bay, via Ketchikan, Alaska.*

Jackson, Charles, *34 Nassau St., New York.*

Mitchell, Hugh C., *Baird, Cal.*

Patching, Fred, *Loring, Alaska.*

Samson, Jas. B., *320 Lewis Bldg., Pittsburg, Pa.*
Stanton, W. C., *International Falls, Minn.*

Webster, B. O., *Bellefonte, Pa.*

(The matter of the nomination of Mr. Downing to life membership was, on motion duly seconded, left with the secretary and treasurer with power to act.)

President: We will now listen to the report of the treasurer.

Report read by Mr. C. W. Willard, treasurer, as follows:

To the American Fisheries Society of the United States of America.

Gentlemen:— I herewith submit my annual report as Treasurer from July 25, 1906, to July 23, 1907.

RECEIPTS.

1906.		
Life membership fees	$ 50.00	
Yearly dues	698.00	
Sale of reports	2.16	
		$750.16

EXPENDITURES.

1906.	
July 25—Balance due Treasurer	$ 26.78
July 25—Dwight Lydell, stereopticon	3.25
Aug. 3—L. W. Arnold, printing	1.75
Aug. 3—Stamps and stamped envelopes	11.70

1907.	
Jan. 8—1000 blank receipts	3.00
Jan. 17—Geo. F. Peabody, Sec'y, reports	315.55
Feb. 10—H. D. Goodwin, stenographer	175.35
Apr. 18—Emma L. Scheffler, stenographer	25.00
May 28—Stamped envelopes	10.70
July 20—Telegram to secretary	.60
July 23—Geo. F. Peabody, Sec'y, postage and circulars	45.16
	$618.84
July 23—Balance cash on hand	131.32
	$750.16

Respectfully submitted,
C. W. WILLARD, Treasurer.

Treasurer: Mr. President and gentlemen, it is certainly a source of great satisfaction to your treasurer, and I suppose to all of you, that for the first time since 1902 we are able to show a balance on the right side of the ledger.

President: The report will be received. I will appoint Mr. C. K. Green, of New York, Mr. W. P. Morton, of Rhode Island, and Mr. B. D. Evans, of Pennsylvania, auditing committee.

The remaining committees on nomination and on time and place of next meeting, I will, with the permission of the society, delay appointing. A number of our members have not come in, being delayed by the lateness of trains. It seems to me proper to wait for the other members before appointing committees.

The report of the program committee is in order.

Mr. Frank N. Clark: The program committee are only able to give a partial report at this time, and ask the indulgence of the association to provide a further report. We find, Mr. President and members, that we are afraid that it is going to be almost impossible to carry our program through of papers, discussions, etc., and business, and try to carry out the program of the committee on entertainment of Erie, but we will do so as far as we can. We now think that it would be better to take up this afternoon Mr. Townsend's paper on "The Cultivation of Fishes in Small Ponds," to be read by the secretary, and Mr. Meehan's paper on "The Shad Work on the Delaware River for 1907 and Its Lessons," and the paper of Mr. Oregon Milton Dennis, secretary of Maryland State Game and Fish Protective Association on "The Necessity of the State Making Laws for

the Protection of Food Fishes after Stocking Waters by the State or United States," and then fill in with some other papers later on. There are so many of these papers that we know that the Washington people and New York people will want to hear, that it has been a little hard for us to sort out what papers to take up. We could take up Mr. Meehan's shad paper now and we knew very likely he could talk on shad afterwards also.

Mr. Meehan: They have all the figures that I will give.

Mr. Clark: It is proposed to have this meeting, and do all the paper work we can this afternoon, and accept the invitation of the committee this evening, and to-morrow morning at 7:30, for the boat ride, and following that we will make another report.

President: Mr. Clark, the secretary tells me that Mr. Townsend's paper is not here. He thinks Mr. Townsend expects to be here. Suppose we substitute in place of his paper the paper of C. Raveret-Wattel.

The paper first read will be that of Mr. O. M. Dennis, secretary Maryland State Game and Fish Protective Association, on "The Necessity of the State Making Laws for the Protection of Food Fishes after Stocking Waters by the State or United States."

Paper read by the secretary, Mr. George F. Peabody.

The paper was then discussed.

Mr. W. E. Meehan, Commissioner of Fisheries, of Pennsylvania, then read a paper on "The Shad Work on the Delaware River for 1907 and Its Lessons," and the paper was discussed.

During the discussion of the foregoing paper, the question of federal supervision of all interstate waters came up incidentally and was considered as follows:

Mr. Bower: It seems to me that is one of the strong points mentioned in regard to federal supervision. It seems to me we ought to have federal supervision of all interstate and international waters. Now, that question has been talked about for the last two or three meetings of this society, and yet nothing has been done by this society. It seems to me, we ought to go about it in a systematic way. There are no dissenting opinions, and

it seems to me your resolutions committee should prepare resolutions along those lines, to be adopted by this society, requesting the boards of the several states interested to introduce at the next session of their respective legislatures a law ceding this right to the federal government. As I understand it, the federal government is perfectly willing to enact these laws and see that they are rigidly enforced, but of course they can't take the initiative. The states must do it themselves. I think it would go a long way, if this body would adopt resolutions, and it seems to me that would be a proper step for your resolutions committee to take.

Mr. Mathewson: Mr. President, I would like to see some thing done on that line. We are certainly in a position in Connecticut where we cannot get anything of that sort from our own legislature. The pound men are too strong for us, and it is only a wonder to me that any of the shad get up through the river at all. Between the pounds and the gillers at the mouth of the river, I have often wondered how any shad get through. And if it could be done by the federal government, I should like to see it done.

Mr. Dwight Lydell, Comstock Park, Mich.: Mr. Clark said he had no trouble in penning up the male shad, and Mr. Meehan also, and the gentlemen back here say they have no trouble in getting female shad. Perhaps they could get at it by penning up just the males.

Mr. Meehan: We had all the males we wanted, generally speaking.

Mr. Lydell: He said females.

Mr. Meehan: That was his experience. He had no trouble about the males.

Mr. Mathewson: Ordinarily we would not, but there were times when we would not get any males at all.

Mr. Meehan: I think it was three times the superintendent reported to me. If he were here now he could tell you.

Mr. Clark: Mr. President, I don't want them to lose sight

of the point that you can pen up the male shad, and they will ripen, but the female shad we couldn't.

Mr. Meehan: Then I should think there ought to be some way of finding that out. We must find it out, that is all.

President: If Mr. Clark is right that the chances of salvation depends on penning the female shad, your salvation is good way off, apparently.

Mr. Samuel F. Fullerton, St. Paul: I suppose you might call me a crank on this federal control business. I have felt very keenly on that subject for years. I have seen the course of states trying to pass laws, and everything turning out to be a farce. That is what it is. Minnesota, perhaps, is worse off than any other state in the Union, because we have got a water course of five thousand miles dividing Minnesota, Canada and our sister states, so that we know some of the evils spoken of here in Connecticut and in the Delaware. It seems to me the meat in the cocoanut of this paper is these nets at the mouth of the river. Get rid of them, and let the shad come up. It seems to me it would be going a long way to solve this problem. It is all important, of course, to find a way to pen the female shad. I think that ought to be persevered in, but it seems to me the first thing to do is to get rid of these netters. Don't let a net be placed in the Delaware river at the mouth in the spawning season, unless they are after the eggs. If you don't have any fish by keeping the fishermen out of there, then find other means of penning the shad. We pass resolutions every session on federal control, then the thing dies, and nothing is done. Why not have this society get out circulars and send them to every representative in Congress and every senator, urging this matter. If the society has not money enough, I will head a subscription list now with $10 to help the thing along. We must work along practical lines if we want to accomplish anything. It is all right to pass resolutions; but we want to go further than that; we must follow these resolutions up with work. Now, I have got pledged in our state of Minnesota every representative, the nine of them, and the two senators, to vote for any measure that comes up along that line. Our state passed a resolution two years ago

ceding any right we had in our waters and in the international waters—whatever rights on Lake Superior bordering on Minnesota. That is in the record.

President: I think Wisconsin has done the same thing this session. Now, let us all get together. Let every man from every state in the union go to work to secure the same sort of legislation.

Mr. Meehan: Mr. Fullerton, are the laws passed by Wisconsin and Minnesota, did you say?

Mr. Fullerton: They have passed resolutions ceding any rights they might have.

Mr. Meehan: Are those laws in what we might call satisfactory and proper shape?

Mr. Fullerton: Proper shape.

President: Aren't you speaking of two different things? The two states have passed laws ceding whatever rights they have to the national government when the national government legislates, but of course no legislation has yet been had by the national government. Mr. Fullerton can speak in regard to the joint legislation of Wisconsin and Minnesota in regard to the Mississippi river.

Mr. Meehan: I was referring to what you are saying about federal control.

Mr. Fullerton: Of course no law has been passed by Wisconsin or Minnesota. It is only a resolution ceding any rights we may have.

Mr. Meehan: Then it is ceded back now?

President: Yes.

Mr. Fullerton: With regard to fishing on the Mississippi river where it forms the boundary between Wisconsin and Minnesota, they would arrest our fishermen and we would arrest theirs, and it was pulling and hauling all the time, and finally a delegation went down there and met a delegation at Madison, and we had a uniform law passed so that the law in Minnesota

and Wisconsin is exactly the same. The same law controls fishing on both sides of the river, and it works very satisfactorily. But the trouble is that we could not get all the states; we could not get Iowa, and could not get Dakota, and could not get Canada where it forms the boundary line. The trouble is that we fall short of what we want. We want the government to take charge, not only to propagate the fish, but plant them.

Mr. Clark: Mr. President, I don't know if we are talking on this paper—may be we are. I understand Minnesota has passed resolutions ceding back any rights, for instance to Lake Superior, when the United States government will pass laws to regulate it. Minnesota and Wisconsin have done that. If Michigan had done that this last winter, Lake Superior could be under the control of the national government.

Mr. Fullerton: That is right.

Mr. Clark: The question, Mr. President, between the Dominion of Canada and our government is a matter to be taken up between our government and the Dominion of Canada. The question first is to get the states to cede this right back. Now, if Michigan had done this last winter, then Lake Superior could be under control of the national government and the Dominion of Canada. That is what we want. Now, Mr. President, while I am on my feet, speaking about circulars and sending them around, wouldn't it be better for this society to take some action, adopt or pass resolutions, if you please, that a certain bill that they might draw up would be what they would recommend to the National Congress for passage? Wouldn't that be something to the point?

Mr. Fullerton: Mr. President, the Shiras Bill is already before Congress.

Mr. Meehan: Mr. Chairman, I would suggest this: That this society, sometime during its meeting, either appoint a special committee to draft a bill, or a resolution similar to that drafted or passed by Minnesota and Wisconsin, to be given to the state commissions or departments of the various states, to be presented to the legislatures of the various states to be passed.

Mr. Fullerton: That is good.

Mr. Meehan: I think that would meet the point. Have a special committee appointed to draft a uniform bill to be given to each commission in each state for presentation at the next session of the legislature. I will say frankly that if such a bill is handed to me it will be handed to the legislature.

Mr. Fullerton: All that is necessary is to pass a resolution by each state government, ceding any rights they have,—not a complicated bill at all, simply a few words. But the Shiras Bill covers the point we want. If anybody wants to read it, it can be gotten in the American Field, Forest and Stream of last May or June. That covers every point that we are contending for. Mr. Shiras has gone into it very fully.

President: I should like to say that we passed resolutions a year ago, and probably on earlier occasions, "that there should be federal control of boundary streams, and that the states concerned should cede their rights to the national government. We heartily commend the efforts of Mr. George Shiras."

Mr. Fullerton: That is the man.

President: We have passed resolutions, and a copy of the resolutions was to be sent to each member of Congress. I suppose that was done.

Mr. Henry T. Root, Providence, R. I.: Mr. President, they only apply to these interstate waters. It would not apply to inland waters like Connecticut. If we find a man putting a trap or nets at the mouth of a river where shad run up, or any other fish, to spawn, we make them remove it. Now, we are going further, or trying to go further with the pound nets. Under our law, the harbor commissioners, if they find an obstruction to navagation, can have it removed, and the pound nets are getting so large there that we are trying to show that they are an obstruction to navigation, and we will get rid of the pound nets in that way. The United States allows navigation, even to naphtha launches, or anything else; they own the waters and nobody has any right to place an obstruction in them,—that is, in salt waters. I think if Connecticut had our laws they could control the migra-

tion of those fish in those rivers entirely. We control it that way. We have some shad streams and they are doing nicely.

Mr. Meehan: We have a law in Pennsylvania which forbids the obstruction of fish, but that will not apply to nets which the law allows to be used, unfortunately.

President: Any further discussion? We might as well finish our discussion of federal control. If there is anything further to be said on that, take it up at this time.

Mr. Bower: Mr. President, you said a resolution of that nature had been passed by this society, directing that a copy be sent to members of Congress. I do not see what effect that has, sending it to members of Congress. They have nothing to do. It seems to me it should be handed to the state boards of fish commissioners and state wardens, and that they be requested to introduce this resolution; that the secretary of this society should be directed to correspond with the various boards and see that the resolution is introduced. The resolutions passed heretofore have covered a great variety of subjects. I do not know of this exclusive resolution ever having been passed by this society—it has been loaded up with a lot of other things, as I recollect it, and it seems to me it should be confined to just that point and nothing else, and the secretary see that what this society has done is communicated to the proper persons, and I think we will get results.

Mr. A. Kelly Evans, of Toronto: In regard to Lake Michigan, where state control is exerted, how far or near does the control begin?

Mr. Clark: Clear over the Wisconsin line. They chase the violators clear into Wisconsin.

Secretary Peabody: On Lake Michigan, for example, there would have to be cooperation by Illinois, Michigan and Wisconsin. That would settle that lake.

Mr. Clark: Settle Lake Michigan.

Secretary Peabody: Then it seems to me that Wisconsin and Michigan, both deeply interested could, through

their fish commissions and those interested in the subject, bring Indiana and Illinois into line, who have little or no interest in it now. Because they have no interest in it now, it would be very easy, to get them to pass such a law, it would seem, and that matter could be settled right there.

Now, again, the matter of the Connecticut river is apparently a local matter. There is no other state interested, and it is purely Connecticut's business to do that. Let them stop netting at the mouth of the river. If they don't want shad, that is not anybody else's business. It is purely a question of where there are a number of states interested, and it seems to me that this society can do very little. It is a question that is up to the board of commissioners of these different states. Perhaps a little effort could be made by this society to get the representatives of these fish commissions to attend our meetings. We have none from Indiana; none from Illinois, I believe, at this meeting, and, of course, these states do not show very much interest in it; but Michigan and Wisconsin both have a deep and vital interest, because it is a matter of great importance to them, and those two states together could easily control Lake Michigan. Now, Lake Erie has again Ohio, Pennsylvania, New York, and that is all.

Mr. Clark: About eight states.

Secretary Peabody: Eight?

President: For all the lakes.

Secretary Peabody: No, not all the lakes—five states. They could get together and handle the matter. I do not see how this society can do any better. Resolutions have been passed from time to time. Agitation is valuable, of course, but if there should be a congress of the fish commissions of the states interested, they might work out a law that would be uniform.

President: There was a meeting held in Chicago two years ago, by the commissioners of the states bordering on the upper lakes, at all events.

Secretary Peabody: In this connection, I will say that a gentleman in Canada interested in this subject has been cor-

responding with me, and promised to be here to talk upon this very subject.

President: Was that Mr. Evans?

Secretary Peabody: A. Kelly Evans. He was very much interested, and I supposed he would be here yesterday.

Mr. Clark: Speaking of the meeting in Chicago, I was at that meeting in Chicago. They have passed resolutions and done everything, Minnesota and Wisconsin have done something; the other states have not. Now, that is all there is to it. They have started the ball. Michigan has not, Illinois has not, Indiana has not, Ohio has not, Pennsylvania has not. At every single meeting of whatever nature, whether it was the commissioners from the states and members of the Legislature, they were all there, and they had a bully good time. They are always unanimous and together and all harmony, and everything else, just as we are here to-day, but they don't do anything—except Minnesota and Wisconsin—and they have, and I say there is the start. They have done something, let the other states get to work and do likewise, and I do not think there will be any difficulty about congress passing the bill.

Mr. Fullerton: No trouble at all.

Mr. Clark: Now Ohio wants to go at it, Michigan wants to go at it, and get the states to pass that resolution, if they have got the right one, ceding back to the national government. Then there is nobody to blame.

Mr. Bower: I don't just agree with the Secretary, that this society cannot do anything. I think it would have a good deal of influence if the secretary was directed to keep track of when the legislatures convene and at that particular time would forward to the state board, or the several boards interested, a copy of the resolution passed by this society, as it would call their attention to the matter. A good many of the members of the state boards are not salaried men; they could not be expected to take up the matter unless their attention is called to it; and when they go before the committees, after this resolution is introduced, it is a very potent, a very powerful argument which

they will have, that this is the sense of the American Fisheries' Society. I know it will have a large influence, and be probably one of the chief arguments they would use. If their attention were called to it and the secretary was directed to see that their attention was called to it at the proper time, I am satisfied that it would have a good deal of influence.

Mr. Fullerton: I thoroughly agree with Mr. Bower. I think it pays to advertise, and everlastingly keep at it and we certainly get before the people by that means. Secretary Peabody and I do not agree, when he says Connecticut is the only state interested in the shad fishing down there. I take issue with him. I am just as much interested in that as they are. I think we are all interested together, all the states. What affects the shad fishing affects us up in Minnesota,—we get cheaper fish. The same with the whitefish interests and the trout interests of Michigan. Down there in Michigan perhaps they are more interested locally, but we are interested also. The more fish they catch in Michigan and other places, the better it will be for Minnesota.

Secretary Peabody: I did not mean to make quite so sweeping a statement. I mean they would have to work out their own salvation.

Mr. Meehan: Is it in order to introduce a resolution?

Mr. President: It is.

The following resolution was then read by Mr. W. E. Meehan:—

It is moved that a committee of five be appointed which shall draft a resolution on the lines adopted by the legislatures of Minnesota and Wisconsin, ceding control of fishery legislation to the federal government, and the secretary of this society is directed to forward a copy to the fish commission of each state with a request that it be introduced at the next session of the legislature, and that every effort be made to have it passed, and the committee is directed to report before the close of the present meeting.

Mr. Clark: Mr. President, I second the resolution.

President: You have heard the resolution read. Do you desire to have it read again? It is open for discussion. If there is no further discussion, I will put the question.

Question put and motion carried.

President: The chair will have to consider the constitution of that committee for a few moments, unless the maker of the resolution has any suggestions.

Mr. Meehan: No, let the chairman appoint a committee.

President: Mr. Townsend, whose paper was set down by the committee for this afternoon, has just come in, but would like to have his paper go over to a later session, and if there is no objection from the program committee, we will take up a paper by E. Raveret-Wattel, Director of the Fisheries Station of the Nid de Verdier, Fécamp, France, on "Observations Regarding the Varieties of Rainbow Trout and the Time of the Spawning of This Species." If there is no objection, the secretary will read this paper.

Secretary Peabody: I might say this is a literal translation from the French.

The paper was read by Secretary Peabody and discussed.

Mr. Clark: Mr. President, I would like to inquire from the Treasurer or some one, what members here have registered, and how many.

President: There have been thirty names registered so far. There are a considerable number here who have not registered, and I would suggest that they register at once.

The treasurer is ready and willing to receive all moneys that are coming.

If there is no further business, the session stands adjourned.

Mr. Clark: Until tomorrow morning at 7:30 on the dock.

President: The program for to-night is to go out to Waldemere Park.

Wednesday, July 24.

The members were entertained by a trip on Lake Erie, at the invitation of the entertainment committee, in the fishing tugs, to witness the setting out of nets and taking in a haul of fish.

AFTERNOON SESSION.

July 24, 2 p. m. Meeting called to order by the president.

President: Before hearing the report of the program committee, I will announce the committees which I announced yesterday would be named at this time.

Committee on Resolutions: I appoint on that committee, Mr. W. E. Meehan, Harrisburg, Pa.; Mr. S. F. Fullerton, St. Paul, Minn.; Mr. S. Bower, Detroit, Mich.; A. Kelly Evans, Toronto; G. T. Mathewson, Enfield, Conn.

Committee on location: Mr. J. W. Titcomb, Washington, D. C.; Mr. E. N. Carter, St. Johnsbury, Vt.; Mr. W. W. Thayer, of Detroit, Michigan.

Committee on Nomination: Mr. Seymour Bower, Detroit, Mich.; Mr. S. W. Downing, Put-in-Bay, Ohio; Mr. A. D. Roberts, Woonsocket, R. I.; Mr. C. H. Townsend, N. Y.; Mr. E. H. Geer, Hadlyme, Conn.

President: Is there any miscellaneous business which ought to precede the reading of the papers.

The auditing committee on treasurer's report, made the following report:

We, the undersigned auditing committee, have examined the account with vouchers of C. W. Willard, treasurer, and find the same correct, with balance on hand of $131.32.

(Signed) C. K. GREEN.
WILLIAM P. MORTON,
BARTON D. EVANS.

President: The report of the auditing committee is before you.

Motion to adopt report, made, seconded and unanimously carried.

The following telegram was read by the secretary: "George F. Peabody, Reed House, Erie, Pa., I propose to honorary or corresponding membership Charlie Poutiau of Lommell, Belgium. C. G. ATKINS."

It was moved and seconded that the nomination sent in by Mr. Atkins be referred to the incoming executive committee, with power to act.

Motion carried.

President: Is there further business of this character which should be taken up now? If not, we will listen to the report of the program committee.

Mr. Clark: The program committee have a further report to make along the lines of papers. It is proposed to take up for this afternoon's session Mr. Townsend's paper on "The Cultivation of Fishes in Small Ponds;" Mr. Leary's paper on "Planting Fish vs. Fry," and in connection with that, Dr. Birge's paper on "Black Bass," and other black bass papers and discussions. Then Mr. Clark's, "Notes on a New Hatching Jar;" Mr. Titcomb's paper on "Progress in Fish Culture During the Past Year;" and Dr. Smith's paper on "Some Observations on European Fisheries and Fish Culture;" and Mr. Olsen's paper on "The Need of an International Fishery Society," and Mr. Atkins' paper on "Manipulation of Salmon Eggs," if we have time; with the discussions. And for this evening, Mr. President and gentlemen, we find that Dr. Mead's paper on "Recent Progress in Artificial Propagation of Lobsters," requires the lantern slides. Therefore, that lecture will occur immediately after the banquet. The banquet will be over with at 8:30, only an hour and a half, so the chairman of the committee on entertainment says, and then we will adjourn from the banquet room to a larger room where they will have lanterns and everything provided for that lecture.

I have made a mistake. Dr. Bean's paper is also to be taken up.

President: I have not the title of Dr. Bean's paper, I believe.

The report will be accepted unless there is objection.

Motion made that the Chair read the program.

President: The program reads as follows: The first paper will be that of Charles H. Townsend of New York; the second, that of John L. Leary, on "Planting Fish versus Fry;" the third paper is that set down for myself, but it is not a paper as a matter of fact, on certain experiments with regard to black bass; the fourth paper is Mr. Clark's on the Hatching Jar; the fifth Mr. Titcomb, "Progress in Fish Culture During the Past Year;" the sixth Dr. Smith on "Some Observations on European Fisheries and Fish Culture;" the seventh, Mr. Olsen, of Grimsby, England, on "The Need of an International Fisheries Society;" the eighth, Mr. Atkins on "Manipulation of Salmon Eggs," and ninth, Dr. Bean's paper on "Practical Difficulties in the Way of Fish Culture."

The question is on the adoption of this report.

Motion made, seconded and unanimously carried adopting the report of the committee.

The first paper then will be that of Mr. Townsend on "The Cultivation of Fishes in Small Ponds."

Mr. Townsend then read his paper which was discussed.

Secretary Peabody then read a paper by Mr. John L. Leary of San Marcos, Texas, on "Planting Fish vs. Fry," which was exhaustively discussed.

In reference to his paper on "Experiments in Raising Black Bass by Taking the Nests away from the Parents and Hatching the Eggs in Troughs," President Birge said:

I am going to begin with a personal matter. I wish to inform the society that my name is not Elias, as stated on the program, but Edward. I wrote to our Secretary, however, that if he could keep Ananias away from me I would not object to his posting me by any other name that he pleased. He seems to think I naturally belonged in the Old Testament; and he seemed to think that I ought to give you a paper, when I wrote to him that I had not got one. I told him that I had hoped to be able to report on this subject of taking the nests away, and say something that would interest the society, but that I found it would be impossible, owing to the lack of facts on the subject; but he, with the abounding faith that he is distinguished for,

in spite of my telling him that it was impossible, placed the title on the list.

I shall hope to say something on this matter next year.

Secretary: Mr. President, there are a couple of notes here from gentlemen who ask some questions on the small-mouthed black bass. It might be pertinent to bring them in.

The questions were then submitted and discussed.

Mr. E. H. Carter of St. Johnsbury, Vt., then read a paper on "Bass Ponds," which was discussed.

Mr. Frank N. Clark of Northville, Mich., then read a paper entitled "Notes on a New Hatching Jar."

The paper was discussed.

Mr. John W. Titcomb, U. S. Bureau of Fisheries, Washington, D. C., will send for publication a paper on "Progress in Fish Culture During the Past Year." Mr. Titcomb mentioned and described the Robinson device for measuring eggs, and then related the following interesting incident in nature study.

If you will allow me, by way of diversion—as you have been having a good deal of serious talk, I will refer to an article which I had the pleasure of reading in one of Mr. W. J. Long's very interesting books, "Northern Trails," about which some of you have undoubtedly heard, on the subject of the salmon. Mr. Long, as you know, and Mr. Roosevelt have had a little tilt on natural history. But Mr. Long has now wandered in the fields of the fish culturist, and he tells in a most interesting way the story of the salmon. He prefaces his book by stating that all of the statements are the result of his personal observations, or based upon information by very reliable guides, except the history of the salmon in the sea, We therefore pass over the history of the salmon in the sea, and read with intense interest the wonderful leaps of the salmon as it descends the stream. In fact, there are a great many interesting stories narrated by Mr. Long in his very interesting way, until he arrives at the spawning ground, when the fish perform their usual functions, and, as he states, the eggs are left to a gently flowing current.

This is the part that will interest you; "The current of water passed continually over the hidden treasures. * * * Beginning his life with hunger, he had at first eaten all that was

left in the egg besides himself and was nibbling at the shell when it broke and let him out. * * * As the egg covering wavered on his tail, he whirled like a wink and swallowed it." (Laughter).

President: Any discussion on Mr. Titcomb's paper? (Laughter). If not, we will pass to that of Dr. Smith on "Foreign Methods of Fish Culture."

Dr. H. M. Smith, Deputy U. S. Fish Commissioner, then read a paper on "Some Observation on European Fisheries and Fish Culture," which was discussed.

Mr. Tarleton H. Bean then delivered an address on "Practical Difficulties in the Way of Fish Culture," which was discussed.

Mr. Clark: I would like to say before adjournment that the committee on program have gone over things as carefully as possible, and with one or two exceptions where they may be printed without being read, I think that if the society will adjourn at the present time to meet at nine o'clock to-morrow morning they can probably get through with their papers.

President: Allow me to say that my paper can just as well be omitted.

Mr. Clark: I was going to say that we only have to consider the papers of Dr. Birge and Mr. A. Kelly Evans of Toronto. Dr. Mead's paper will be read to-night; of course you will understand that. Mr. Evans' paper on "The Influence of Politics upon the work of the Fish Culturist, and How Fish and Game Protective Associations May Assist the Latter," and also on "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes," will be read. Then there is a paper by Mr. Field, chairman of the Massachusetts State Fish Commission. That paper really ought to go along with the paper of Professor Mead to-night, I should presume. Those are practically all the papers, with the exception of the paper by Mr. Atkins on the "Manipulation of Salmon Eggs," and the report on "Foreign Correspondence," which Dr. Smith informs me will only take a short time, and then there are one or two

others here that we may perhaps have time to take up. I think we will have no difficulty in getting through by to-morrow between twelve and one, so that those who wish to leave in the afternoon may do so.

Dr. Smith: There is a provision in our constitution, for miscellaneous business. Before adjournment, please give me two minutes to present a resolution.

Resolution read by Secretary Peabody as follows: Whereas, The American Fisheries Society, in annual meeting at Erie, Pennsylvania, has learned with regret of the continued illness of our fellow member and pioneer fish culturist, Livingston Stone, one of the founders of the society; therefore,

Resolved, That we send greetings to our stricken associate and extend our sincere sympathy to him and his family.

Resolved, further, That the secretary acquaint Mrs. Stone with this action of the society.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

President: I think it would be proper to adopt this resolution by a rising vote.

Resolution carried unanimously.

President: The secretary will transmit the information regarding the action of the society.

The society stands adjourned until 7:30 p. m., for the banquet.

Proceedings at the Banquet held at the Reed House in the City of Erie, Pennsylvania, July 24.

Mr. Meehan of Philadelphia acted as toastmaster.

Mr. Meehan: Gentlemen, someone once said, "Eat, drink and be merry, because to-morrow you go fishing,"—or something to that effect. (Laughter). About a year ago, or just about a year ago, we met at Grand Rapids, and there the question came up of where we should meet the next year. I had the hardihood to propose the city of Erie in Pennsylvania. There was some little doubt about whether it was good policy to come to Pennsylvania—(Cries of "No doubt about it now"),—for

fear the city of Erie might be a backwoods town; but after some little persuasion, it was agreed to, and the invitation of the chamber of commerce of the city of Erie and of certain of the newspapers was accepted, and we are now here. I would therefore, like to have Mr. H. T. Leasure, the secretary of the chamber of commerce of Erie, tell us how it is that he has had so much of the milk of human kindness as to bring us here and give us such a hearty reception as we have received here.

Mr. H. T. Leasure: Mr. Toastmaster, Ladies and Gentlemen: I am sorry that your toastmaster has made the mistake of the evening in starting out by calling on me to address you, for I assure you that if my position depended upon my ability to talk, I would not have it for twenty-four hours.

Again it is rather hard, after sitting down and partaking of a meal like this, not knowing that you are going to be called upon, to be suddenly subjected to an ordeal like this. I don't know it from practical experience, but I have heard it said that a man cannot talk well on a full stomach, and I have eaten a very hearty meal. That makes me think, of course, of a little incident that I read, where one of our humorists was traveling, and he went into the diner and sat down opposite a lady with a small child about four years of age. The child was taken care of by the lady, and got what it wanted to eat, and afterwards got cross and acted rather badly, and he made the remark if he had a child which acted like that, he would give it a good spanking. The mother replied, "I do not believe in spanking a child on a full stomach. He replied, "No, I think you might turn it around." And I think if I could have spoken before I had a full stomach, I could possibly have said something. (Laughter).

I assure you, that it has been a great pleasure for the chamber of commerce to entertain you. We have had a great many conventions in the last four years, invited here by the chamber of commerce. We have always tried to please them. I do not know of any instance where they have gone away not pleased with our entertainment and their treatment.

I may say that this convention is not as large as we expected, but what it lacks in number, it has surely made up in quality. I do not think we have ever had a more representative

crowd of men at a convention in our city than the American Fisheries' Society convention. (Applause).

Although few ladies have honored us with their presence, I have been told that it is not customary for the ladies to attend these conventions; but we urged that the invitation should be extended, and we were in hopes that quite a few might have accepted, and, as in the case of the gentlemen, although you are not here in great numbers, I assure you you have the quality in what you have presented here. (Applause.) In appearance they can't be beat. (Applause.)

I tried to persuade the toastmaster to call on some of the other Erie gentlemen, as we have a few here who can speak, but he said, "I do not know them very well, and I do know you, so I am going to call on you first." I told him I could talk probably two minutes and that would be the end of it.

I hope that in the future when any of you gentlemen are coming through to the west, or from the west to the east, you will find it convenient and to your pleasure to stop off in Erie. I would deem it a pleasure to show you through our town I assure you that we have not had the opportunity to show you our city as we would like to show it to you. It seems as though your program is long, and you do not seem to be able to spare the time to take in much pleasure. But, if at any time after this convention, you are able to stop in this city, I will take pleasure in showing you over it. It is a beautiful place. I assure you our people welcome you here. We enjoy the reputation of being one of the most hospitable cities in the state of Pennsylvania. We have had a great many conventions, and they go away well pleased from our city, and are always willing to vote to return, and I hope that we may in the near future entertain you again. I thank you.

(Great Applause.)

Toastmaster: This afternoon, during one of the intermissions, I was out on the sidewalk, and I was hailed by my friend Commissioner Bowers. He said, "Look here Meehan, I want to speak to you a minute, and if you are a good friend, you will do what I want." He said, "I hear you are going to ask me to speak to-night and I don't want to do it, because I know my

family don't like me to do such things; but I will tell you what you can do, you may call on Smith, he likes that sort of thing." I will, therefore, call on Dr. Smith, as the representative of Mr. Bowers. (Applause.)

Dr. Smith: Mr. Toastmaster, Ladies and Gentlemen: this is a mean trick, (laughter) and I promise you that I will get even with Commissioner Bowers one of these days. I want to take as the subject of my toast an epistle I got a short time ago from a citizen of the commonwealth of Pennsylvania. It was more than a coincidence, perhaps almost an inspiration, that on the eve of my departure from Washington to Erie, I should receive a letter, which I believe will rank as one of the most remarkable documents that has ever passed through the United States mails. It is quite evident that this communication was intended for the consideration of the members of the American Fisheries' Society, but it contains some matters of local interest, which lead me to believe that it should finally reach the department of fisheries of Pennsylvania. This is the communication,—and one of the special features about it is that the postal authorities, realizing the firm hold that Pennsylvanians have on Uncle Sam, were willing that this should go through the mails without a postage stamp, (laughter) but that is not all—the form of this letter certainly deserves consideration. It is on two sheets, which I will now exhibit. (Laughter.) More remarkable than the form is the matter. I shall have to withhold the name of the correspondent, also his address, because somebody might become offended; but I should like to read this letter and leave it to you to ponder over:—"Can't you raise salt water fish in fresh water rivers and cross them in ponds in Pennsylvania? Can't we cross the herring that run up rivers with the shad and make them larger? Put in fresh water ponds gradually, do it gradually. We have fruit crossed and made to grow larger. We have horses, birds, etc. crossed for better stock. In California a man is crossing fruits and flowers, using hypodermics of sap and blood. Try a hypodermic syringe. Cedar and pine, evergreen trees, saps into maples to make them keep in leaf all winter, and make a manure that will make cedar trees, arbor vitae, gum trees, and persimmon trees grow faster. Send me word,

please, when this is accomplished. I think all this should be patented, and the patent right sold, and that I should be given a share in the profits." (Great laughter.)

This Pennsylvanian makes my speech for me. (Laughter and applause.)

Toastmaster:—The letter is almost equal to one which I received some time ago when the news got abroad that our trout had sore throat and the department got a letter, "Try camphor." And that reminds me that when the chamber of commerce made up its list of members of the reception committee, they did not forget to put thereon several people who are intimately connected with fish work, and one of them was the Chairman, Mr. Hinrichs. Now, I think that those of us who live upon the borders of the great lakes, and perhaps all of us, would like to know very much how Mr. Hinrichs, or his captains, manage to keep themselves free from the Canadian revenue cutter.

Mr. Hinrichs: Mr. Toastmaster, Ladies and Gentlemen: This is another surprise. I understood that in the speech making to-night no member was to be called upon.

I can say that we have not had trouble with the Canadian authorities. We have had the pleasure of hearing from the Ontario Game and Protective Association, and the head of that association, after he realized the amount of propagating that the state of Pennsylvania had done, said, that he did not blame the Yankees for crossing the line occasionally to get some of the fishes which had been planted by them. But in mapping out the program, there is one feature that we overlooked, a feature that would have made Erie prominent in the eyes of the world, namely, we should have carried out the idea of getting Captain Dunn of the Canadian boat Vigilant posted as to the proposed trip of Commissioner Meehan on the lake to-day. I want to tell you confidentially that the boat did not return until two o'clock. Now, there is no boat that can go out in the direction which that boat did and stay until two o'clock without crossing the Canadian line. If Captain Dunn had been informed of the proposed attempt to cross the line to-day, we would not have had the pleasure of Mr. Meehan's company this evening; he would be in the custody of the Canadian authorities.

I want to say to you that it has been a sincere pleasure for the committee to entertain you. We regret that your program has been so long that you could not take in all the opportunities that we had provided for your entertainment, and if you should ever come back to Erie, which we sincerely hope will soon materialize, you will be welcomed heartily. We hope your convention will meet here again inside of three years. We assure you, you will never have a better time. Notwithstanding the fact that the next international convention will meet at Washington, D. C., Erie cannot claim of course to out do Washington with all its attractiveness, but, year after next we hope you will be with us again, and whatever committee has charge of arranging the convention at that time, I hope will bear this in mind.

I thank you for the pleasure you have given us, in the opportunity of entertaining you, and we will always fondly remember your visit to this city. (Great applause.)

Toastmaster: There are two or three questions that come before the Fisheries' Society, which have, by common consent, usually been barred. One is the German Carp, and the other is Fry vs. Fingerlings. Now, if our friend Bartlett was here, I would call on him to tell what he knew about carp, just for the fun of the thing; but, as he is not here, I think we will call upon Dr. Birge to tell us how he kept the meeting to-day from getting into a row over fingerlings and fry. (Applause.)

Dr. Birge: Mr. Toastmaster, Ladies and Gentlemen: I really do not know how I succeeded in doing that, but I think I did it in a masterly manner. I have presided over this meeting with a good deal of trepidation, and when the subject of Fry vs. Fingerlings came up, I thought I was in for it sure. When I get into an assemblage of university men that are engaged in managing the affairs of universities, I generally feel that I can at least keep quiet with dignity, because I know something about what is going on. But when I get in here with a lot of practical fish men who are actually doing things in the matter of breeding fish and taking charge of the larger affairs of the fishery industries of the country, I feel myself a good deal at sea, and I am always afraid that somebody will get after me, somewhat as the

New Jersey farmers did after a former governor of our state, Governor Hoard. If there were more than one representative of Wisconsin here, or if I were not more than five hundred miles from home, I should not dare to tell one of his stories because he tells them very admirably and I very badly.

Governor Hoard was down in New Jersey at a clam-bake—not of the variety of clam that our Rhode Island friends gave us, but the little neck clam. He was called on for a speech at the close of the clam-bake; he referred to the bivalve of which he had been partaking, and referred to it as the "low neck" clam. One of the old farmers said: "It ain't low neck, it is little neck." Hoard gave him a glance and went on with his "low neck" clam to the end of the speech; but when the speech was over the old farmer came up and said: "Governor Hoard, I reckon you don't have many clams out there in Wisconsin." The Governor says: "No, we certainly don't; they don't do very well; it is a prairie state, and driving the clams across the country to water, they get foot sore, so we don't raise a good many clams out there." The old farmer was so astonished that he simply exclaimed "Gosh!" and after leaving asked," Is that man governor out there in Wisconsin?" When told that he was, the farmer commented, "Well, he may be all right for governor of Wisconsin but get him down in New Jersey and he ain't much better than a d——d fool." (Laughter.) Now, I have been afraid all the time, especially when this question of fry and fingerlings came up, that somebody might say that I was all right as fish commissioner of Wisconsin, but when I got in with practical fish men, I was an ignoramus. So, Mr. Toastmaster, I think you will agree that I concealed my ignorance in a masterly way; and I assure you if you will bring up the carp question to-morrow, I will do the same thing and conceal my lack of knowledge as capably as I did this afternoon.

Before sitting down, I want to express the thanks of the society to Erie for the admirable entertainment they have given us, and I wish to express our regret that we could not take all of the pleasant trips and share in the pleasant amusements which were so hospitably planned by the reception committee. But we have enjoyed thoroughly those trips which we have been able to take. I was especially glad that the practical fishermen here entered

into the spirit of the meeting and demonstrated to us the practical workings of the netting industry which is so important to this city and the fisheries of the great lakes.

So we wish to express our thanks to the committee, and our hearty enjoyment of everything they have done for us, and our sole regret is that they have planned so much which we have been unable to enjoy. (Applause.)

Toastmaster: Many years ago, when I was first introduced into the mysteries of fish culture, I met a gentleman who at that time was deeply involved in the subject, and we have become very firm friends; and I know we will continue so until the end; but nearly every time I see him, and that is about once every six months, he is in a new business; and I think we would like to have Dr. Tarleton H. Bean explain to us just what his business is.

Dr. Bean: Mr. Toastmaster, Ladies and Gentlemen: I am blessed if I know. It is very difficult to tell just what business may come up in a fish country. I suppose that fish culture does take up a great part of my time. But I certainly have had a great deal of trouble of late with some of my constituents from Missouri—you remember, I am from Missouri. I was born in Pennsylvania and moved to Missouri, and cast my first vote in Missouri. Well, out in Missouri, going out with my dear old friend the chairman of the fish and game committee of the exposition, fishing down in the Ozark mountains, I heard a fairly good story. There is a country in the middle of the state, in which the inhabitants are not thoroughly familiar with the English language, and they depend upon the general store keeper who is also the postmaster, to give them the news. He reads the weekly paper and explains it to them. So he is the translator of the current news of the weekly paper. This man was reading the paper one day to his townspeople, and among the items of interest that he read was the following: "There is going to be a great slump in the price of corn, owing to the great influx of immigrants in this country." They listened to it, and said: "Well now, what is an immigrant? What does that word mean?" He always had an explanation ready, or tried to have, so he scratched his head and thought awhile. He didn't know what it meant

himself, but he had to pretend he knew—just as we do sometimes—and finally said: "An immigrant, I know what that is, it is not quite so big as a raccoon, a little bigger than an opossum, but hell on corn." (Great laughter.)

That is just the way with us in the present business of fish culture. We come across this little immigrant, brought from Europe, or Great Britain, or New Zealand—wherever we may happen to get a supply, new elements for the American fish, and this miserable little immigrant plays smash with our native species. We have lots of cases of that kind—little observed—that sweep in among our trout and sweep them off by the tens of thousands. And so we should be obliged to our Missouri friend, who has so carefully explained to us the meaning of the word "immigrant." (Applause.)

Toastmaster: There is a little state in the Union called Maryland, and they have got some peculiar things down in Maryland. It is a jolly little state to get into, I will tell you, but there is one thing I know we should all like to know about, and that is, how it is that the fish commissioner of Maryland managed to get an appropriation of $4000, to buy eels to furnish the legislature with annually. I will ask Mr. Brooks for an explanation of that apparent anomaly. (Laughter.)

Mr. Charles F. Brooks, Sandy Springs, Md.: Mr. President. Ladies and Gentlemen: I am not an after-dinner speaker, in any sense of the word. I never undertake to make a speech. The question Mr. Meehan has asked me, I cannot answer at all. But I can tell you all one thing, and that is, if you come down to Maryland—that good old place where they have the terrapin, canvas-backs and oysters and all manner of eatables, to say nothing of hog and hominy and backwoods cakes, you will never regret it. He came down there and we entertained him the best we could; took him out on the rivers, those beautiful rivers along the bay, and did not undertake to drown him or do anything of a serious nature to him.

Now I want to tell you how different his treatment was of me, when I started to come up here, and I lay it all to him. I would like to know, if anyone can tell me, why he wished to treat a gentleman from Maryland in this way. In the first place, in the

still watches of the night, he placed a freight train on our track and let us run into it full speed. I have secret information that he was at the bottom of that whole thing. (Laughter.)

Mr. Meehan: I had to give you some excitement.

Mr. Brooks: I fortunately escaped that and came on here, and he then tried to kill me with good cheer, but he found out that by good treatment I only prospered. So to-day he took me out on this beautiful lake out here and gave me a pleasant outing, very pleasant—most of the time. (Laughter.) He showed us how the nets were taken up and how the fish were secured—very few of them I must say—he will have to come down to Maryland in order to get many fish. Then he showed us how they were put down. But for some reason some of the members of the party did not feel very comfortable, and when I appealed to the commissioner, his treatment of me was not what I expected. I wanted him to give me something to do me some good, to raise my drooping spirits; instead of that he sang the old song to me. The quotation was applicable, Commissioner Meehan. And the commissioner said to me: "There are plenty of fish down in the brook; all you need is a line, a rod and hook." I believed him that there were plenty of fish, and all wanted to come out very badly. I had a most uncomfortable time. The commissioner found that I even survived that trip out on the lake, and to add insult to injury, he gave me no ticket to-night to this banquet, expecting me to go supperless to bed. If any of you can explain that treatment I shall be very glad to have you do so. (Applause.)

Toastmaster: I will leave it to any man in this room whether or not he deserves a ticket to this banquet, because while we were out on the boat and while he was uncomfortable, I offered him a good plump, fat ham sandwich, and he rejected it. (Laughter.) After that, naturally I supposed he didn't want any supper or dinner.

The hour is growing late, and we have some other work to do, but we have one or two speakers who should have something to say about things of interest. Among other things, it has been a well known fact that for many years the American Fisheries

Society has owed its treasurer a good fat sum. I understand now, that he has got his money back, and I would like to know how he worked it.

Professor Birge: He has gone upstairs.

Mr. Meehan: I will have to pass him by then.

As a conclusion I would like to hear from the president of the chamber of commerce of Erie.

President Arbuckle: Mr. Toastmaster, Gentlemen of the American Fisheries Society and Ladies: I have certainly enjoyed meeting with you gentlemen during this convention, and we are glad to have you with us. What I know about the city of Erie would take a good while to tell. One of the things that I can say to you is that we have a chamber of commerce consisting of over nine hundred members, and every one of that nine hundred wishes you welcome to the city of Erie, and hopes you may come again.

We have a city that has entertained some notables, and we are glad to have you come here too. We consider the American Fisheries Society as among those notables. We think that they have done a great deal for Erie. We think that when they have stocked the lake with whitefish and made it possible to take 75,000,000 pounds of whitefish out of Lake Erie in a year, that the American Fisheries Society has done something for Erie. I know that there are a great many fishermen here. I know that they make their living out of the product of that lake, and I know that we owe their prosperity to a great extent to the stocking of the waters by the fish commission.

As regards Erie, we have a very prosperous city, a very large manufacturing city. We build more boilers and engines here in Erie than any other city in the world, and have the largest shops in the world for that purpose. We are getting ready to welcome the General Electric Company, which will build a very large factory here in the immediate future, and we expect to have others follow them. Our prosperity has been coming to us for a long time, but more particularly in the last six or seven years, since the chamber of commerce was organized. Of course we have other civic bodies here, but none of them as large as the

chamber of commerce. They have all joined together, and we have got together, and we are all ready to welcome you when you come again, gentlemen, and we hope that it may be soon. (Applause.)

Toastmaster: I know that we would all like to stay a little longer. I know there are a number of experiences of our people which we would like to hear and know, but the hour has arrived when we must get down to business, and I hereby declare this banquet closed. The members and friends here will go to the large room on the floor above, where the president will call the meeting to order, and the business will proceed. It will be a lecture by Dr. A. D. Mead on "Recent Progress in Artificial Propagation of Lobsters," which will be illustrated. (Applause.)

After the banquet the meeting adjourned to the lecture room in the Reed House, where Professor A. D. Mead delivered an illustrated lecture on, "Recent Progress in Artificial Propagation of Lobsters," which was discussed.

Recess until next day, same place, 9:30 a. m.

Thursday, July 25.

Meeting called to order by the president.

President: Is the committee on location ready to report?

Mr. Titcomb: Mr. President, may I see the 1905 report? (Report submitted to Mr. Titcomb.)

Mr. Titcomb: The committee on location finds that they have very little to do. At the meeting of the society in 1905, a resolution was adopted which I now read for your clear understanding: "Whereas, the American Fisheries Society, in annual convention assembled at White Sulphur Springs, West Virginia, has learned of the action of the International Fishery Congress in designating Washington, D. C., as the place of meeting for the next congress: therefore

Resolved, That this Society hereby expresses its gratification at the honor thus conferred on the United States by the body of dis-

tinguished foreign authorities composing the late International Fishery Congress.

Resolved, That we pledge our individual and united efforts to promote the success of the Washington Congress, and will accord all practicable assistance and support to those having charge of the arrangements.

Resolved, That at the proper time the president appoint a committee of seven members to officially represent the society at the Congress; the said delegates to represent the different geographical sections of the country as far as practicable.

Resolved, That the Society hold its regular annual meeting at Washington in 1908, in conjunction with the International Fishery Congress."

Your committee therefore recommend that, pursuant to this last resolution, the next meeting of the Society be held in Washington, D. C. That the meeting be called on Monday morning, September 21st at 10 o'clock, to be continued from that time as long as necessary to complete the business. On this subject, I think Dr. Smith can give you some information, which will make this date appear the desirable one for holding the meeting.

President: We shall be glad to hear from Dr. Smith.

Dr. Smith: Mr. President and Gentlemen: I have no very definite views as to the course of procedure in the case of this double meeting to be held in Washington next year. I should not favor the merging of the American Fisheries Society in the International Fishery Congress. I think we should hold an independent meeting. But, in order that the meeting may not be unduly prolonged, it seems to me that we should be willing on this special occasion to condense our proceedings as much as possible; have all the essential business conducted and have presented such papers as are of rather local interest, leaving papers of more wide-spread interest to be presented at the International Fishery Congress.

The International Congress has been called for Tuesday, September 22nd, and the sessions will continue for four or five days. It seems to me, Mr. President, that there is reason to believe that owing to the peculiar conditions attending the next meeting of the society, there should be one of the most interesting and important gatherings ever held in this country in connection with and in interest of fisheries.

I believe all of the members have received copies of the an-

nouncement in regard to certain awards which have been offered by the International Fishery Congress. This Society has offered an award of $100.00 for a certain purpose. I hope, for the honor of the society and of the country, that the members will compete freely and will carry off a large number of these awards. Certainly there are no people in this country or anywhere else who are better qualified to enter this competition than the members of this society.

President: The question is on the adoption of the report of the committee on time and place of meeting

Mr. Clark: Mr. President, I move the adoption of the report of the committee.

Motion seconded.

Report adopted unanimously.

President: Is the committee on nominations ready to report?

Mr. Seymour Bower: I will say that the committee on nominations had a very harmonious and pleasant meeting, and the selections that were finally decided upon were unanimous in every instance; although I might except our treasurer; one of the committee rather protested against him. I do not know why, unless it is that he is in the same state and knows him better than any of the rest of us. And I do not feel just right about renominating him myself. He stated at last year's meeting, that if there was a deficit, he would meet it, and I understand he has done so a number of times. He also stated that if there was a surplus, he would divide it, and he has not been around to see the committee on nominations yet. (Laughter.)

The nominees finally decided upon were, for president, Dr. H. M. Smith, Washington, D. C.; for vice president, Dr. Tarleton H. Bean of New York; for recording secretary, George F. Peabody, of Appleton, Wis.; for corresponding secretary, Charles G. Atkins, of East Orland, Maine; for treasurer C. W. Willard, Westerly, R. I.

For the executive committee, the following:

Chairman, W. E. Meehan, Harrisburg, Pa.; G. T. Mathewson, Enfield, Connecticut; Frank Miller, Put-in-Bay, Ohio; G.

V. Jennings, New York; Dr. S. P. Bartlett, Quincy, Illinois; Dr. G. W. Field, Boston, Massachusetts; W. P. Morton, Providence, Rhode Island.

The committee has no further report to make, except that we earnestly recommend the adoption of the report.

(Signed) SEYMOUR BOWER,
Chairman Committee on Nomination.

President: The question before you is, on the adoption of the report.

Motion made and seconded that the report be adopted.

Report adopted unanimously.

Motion made, seconded and unanimously carried that the rules be suspended and the secretary be instructed to cast the ballot of the society for the nominees.

The secretary so cast the ballot and the president announced that the nominees were duly elected to their respective offices.

President: Is the committee on resolutions ready to make its report?

Mr. Meehan: I would like to have the privilege of presenting our report in sections, as the exigencies of the occasion arise. Two or three things have come up, and we can very likely fix it in that way.

President: Very well.

Mr. Meehan: I would first like to read the resolution in regard to the passing away of a number of the members during the year.

Resolution read by Dr. Meehan as follows:

During the year our ranks have been depleted by the scythe which is no respecter of young or old. Their work and counsel will still be at our command, but no longer will they in person inspire us to new achievements. However, we can go along the paths that they have hewn out; and the world may not know except in this tribute that we pay, how much they did to better the world that they lived in. It is we that have known them personally, who fully appreciate their work; but, like the tiny coral insect, who builds up his nest that in time makes an island,

these men have added to the knowledge that gives to fish culture its potentialities as one of the great sources of the food supply of the struggling millions of the world.

Those who have gone from among us are:

C. J. Bottsman, Burgen Op Zoom, Holland, 1906; John H. Howell, New Bern, N. C., August 1, 1906; S. H. Kauffman, Washington, D. C., 1906; George F. Lane, Silver Lake, Mass., July 17, 1906; George A. Wride, Grindstone City, Mich., August, 1906; Bernard L. Douredoure, Philadelphia, Pennsylvania, spring of 1907; Fred J. Adams, Grand Rapids, Mich., spring of 1907.

Mr. Meehan: The resolution is offered for passage.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

Resolution adopted unanimously by a rising vote.

Mr. Meehan: The committee on resolutions desire also to offer the following resolution for adoption:

Resolved, That the thanks of the society be cordially given to the chamber of commerce of the city of Erie, its reception committee, and the citizens of the city of Erie, and commonwealth of Pennsylvania for their royal entertainment, the courtesy extended, and their hearty and abundant hospitality.

Mr. Clark: I move the adoption of the resolution.

Motion seconded.

Resolution carried unanimously.

Mr. Meehan: The committee would like to have a recess for a little while.

President: Is there other business to come before us at this time?

Mr. Clark: The committee on program would simply make as a last and final report, the statement that the balance of the papers to be read are, Mr. G. W. Field's on "The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries;" Mr. Charles G. Atkin's on "Foreign Correspondence," and on "Manipulation of Salmon Eggs;" Dr. Birge's on "The Respiration of a Lake;" and Mr. A. Kelly Evans' on "The Influence of Politics Upon the Work of the Fish Culturist,

and How Fish and Game Protective Associations May Assist the Latter;" also on, "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes;" and we would move that the balance of the papers be published without reading.

President: Those in favor of the adoption of the report as read, will say "Aye".

Opposed, "No".

Report adopted unanimously.

Dr. Smith: I should like to bring to the notice of the society, a communication from Mr. R. B. Marston, editor of the Fishing Gazette, London, England. He is greatly interested in the American Fishery matters, and I believe the members of the society will be glad to have this communication from him in regard to striped bass:

"We hope to try the striped bass in our waters. Would it be troubling you too much to tell me what would be the best way to try the experiment? If the striped bass could beplanted from the Atlantic to the Pacific, why not from one side of the Atlantic to the other? Perhaps you know some man well up in striped bass, who would undertake to get together some striped bass of both sexes, and ship them to us at Southampton, probably from Providence. If you know of such a fish culturist, please give me details, as I shall have to send the hat around and get the money, and must know before hand what the expense will be. My friend the Honorable Daniel B. Fearing, of Newport, R. I., is also a member of this society, and has promised me five pounds of bass; and I hope to have little trouble in getting the money. Our British Sea Angler Society has at last gotten interested. I have been advocating the trial of this splendid game fish for two or three years."

Mr. G. W. Field, Chairman Massachusetts State Fish Commission, then read a paper entitled "The Necessity of the Protection of the Adult Lobster, in Order to Maintain the Lobster Fisheries," which was discussed.

President: Do you wish to present any resolutions at this time, Mr. Meehan?

Mr. Meehan: Yes.

President: Then we will hear from the committee on resolutions.

Mr. Meehan: The committee has directed me to present the following resolution:—

Resolved, That the secretary of this society be directed to prepare and forward a copy of this resolution to the fishery officials or other proper officials of the several states interested, with the request that they have the same presented to the next session of their legislature and use every effort to have it adopted:

Resolved, by the Senate and House of Representatives of the State of ....., in Assembly met, that the State of..... cedes to the National Government any right or title it may have or jurisdiction over the fisheries in any waters forming the boundary between this and any other state so far as this state has jurisdiction and also over the fisheries of the waters of the Great Lakes which form a boundary line between this state and a foreign government.

President: I would be glad if that might be read once more.

Resolution reread by Mr. Meehan.

Mr. Meehan: I should say that the committee knew, in fact, that in some states this would not be exactly correct. It would not be for our state, for instance, so far as the Delaware River is concerned, because we would have to add to that that this shall go into effect when the state of New Jersey passes a similar law. There is a treaty by which they have concurrent jurisdiction, and consequently it would be a concurrent resolution between the states; but this was merely some sort of a formula for a draft of a resolution.

President: We will consider this resolution. The question is on the adoption of the report by the committee. Are there any remarks on that? The phraseology of that resolution, is, I am sure, somewhat different from that which we passed in Wisconsin; and I do not believe that would have passed, although it amounts to nearly the same thing. Would it not be a good plan to have the secretary make his letter deal with the general subject of the cession of control, and then submit, by way of showing what has been done, copies of Minnesota and Wisconsin resolutions, rather than try to make a formula, as though we had a particular formula which the society wanted to have adopted?

Mr. Meehan: Mr. Chairman, this resolution was drawn in accordance with the instructions of the society. The society instructed this committee to draft a bill or resolution to be presented to the various state legislatures. That was why this was done in this way.

President: The question is on the adoption of the report. Those in favor say "aye," opposed "no."

Motion carried.

Mr. Meehan: I am directed by the committee to present the following resolution:—

Resolved, That this society reaffirm its resolution adopted at its meeting at Grand Rapids, Michigan, last year, in support of the Shiras bill giving federal control of boundary waters.

President: The question is on the adoption of the report.

Those in favor of the adoption of the report will signify by saying "aye," opposed "no."

Motion carried.

Mr. Meehan: I am requested by the committee to present the following resolution:—

Whereas, for several years, the members from the state of Rhode Island have presented suitable souvenirs to the members of the American Fisheries Society at its meetings, therefore,

Resolved, That the sincere thanks of the society be extended to the Rhode Island members, together with a sense of its appreciation of the feeling which prompted the gifts.

(Applause.)

Resolution voted upon and carried unanimously.

Mr. Root: I think that resolution ought to be more personal, and confined to Mr. Roberts entirely. If he has a bill, we will pay it. But it is his idea in presenting these souvenirs.

Mr. Meehan: I am directed to present one more resolution, but the committee would like to hold this resolution until Mr. Evans of Toronto has said what he has to say.

President: I will call on Mr. A. Kelly Evans, of Toronto, for his paper on "The International Problem of the Proper Regulation of the Fisheries of the Great Lakes," and also take up at the same time, his paper on "The Influence of Politics

Upon the Work of the Fish Culturist, and How Fish and Game Protective Associations May Assist the Latter."

Mr. Evans delivered an address on these subjects, which was discussed.

Mr. Meehan: The committee has directed me to offer the following resolution for adoption:—

Resolved, That it is the opinion of this society that immediate steps be taken in the direction of using its influence to call an international conference of representatives of the sovereign states, bordering on the great lakes; the province of Ontario, the Dominion government and the Federal government at Washington, for the purpose of discussing means, measures and regulations of a uniform character to improve the fisheries of the great lakes and the waters adjacent.

President: The subject is now open for discussion by the society.

Mr. Meehan: That concludes the report of the committee on resolutions.

Mr. Fullerton: Would it not be a good idea, to have the secretary of the American Fisheries Society, send a communication to the governors of the different states, requesting them at a certain date, to name a representative to meet a like body from Ontario and Canada? Would we not get at the matter directly in that way, by having our secretary here do that; that would be official.

Mr. Meehan: Do you make that as an amendment to that resolution?

Mr. Fullerton: I am not criticising the resolution, but it strikes me that would be a good way to get at it directly, and accomplish something; have the secretary write to the governor of each state bordering on the great lakes—I think there are eight or nine states directly interested—to meet the representatives of the Dominion and Ontario governments.

President: It seems to me that this is intended to be an informal meeting. I gathered from Mr. Evan's paper that an informal gathering was desired first.

Mr. Evans: I think the idea of the committee on resolutions was, while it was to be informal in a sense, at the same time that the representatives would be largely the officials connected with the bureaus of the different states. Was not that the idea?

Mr. Meehan: That was the idea.

Mr. Fullerton: My idea was that this committee that was to meet a like body from Ontario and the Dominion of Canada —it would not be binding—they could not bind the different states to anything.

Mr. Meehan. Yes.

Mr. Fullerton: But they could lay a foundation, and recommend to the Dominion government and to the government at Washington their recommendations; which would be, in my estimation, a good deal more binding than if the other was taken up first. Let us have a preliminary meeting, if you wish, of the states interested first with the Dominion and the Ontario governments, and then with the other two governments afterwards.

President: If it is desired to accept this amendment, it will be so considered.

Mr. Meehan: I am instructed by the members of the committee, to accept that as an amendment to the resolution that was offered; rather, to add it to that, as it is not an amendment now.

President: It stands a part of the report.

Mr. Meehan: That the secretary of the society be directed to request the governors of the states bordering on the great lakes, the president of the United States, and the governor general of Canada and the lieutenant governor of Ontario, to appoint on a certain date, delegates to this international conference.

President: I would point out that this throws upon the president and secretary of the society the burden of making all the arrangements for this conference.

Mr. Meehan: I think it will come on the executive committee, Mr. President; they transact business in between times—apart from the secretary's writing this communication.

Mr. Evans: I think another advantage, Mr. President, in doing it in that way, is that of course, if delegates were appointed by such powers, naturally the expenditures would not fall upon the individuals present. I mean that if the province of Ontario department sent over any delegates representing them, naturally, the province of Ontario would foot the bill. It would not be any expense on the fisheries societies.

President: I should like to hear from Dr. Smith. I should like to ask whether it is the experience of those who are familiar with such matters, as I am not at all, whether governors and presidents and governor generals, will appoint official representatives on the invitation of a society which has a scientific standing like our own, or will respond better to an official invitation from somebody having governmental standing. I would like to hear from Dr. Smith in regard to the matter.

Dr. Smith: I cannot speak for the states, but I think in the case of the United States Bureau of Fisheries, that we should be glad to designate delegates for this purpose. I hope this set of resolutions will pass. But I would call attention to the fact that for twenty years there have been conferences held between the states and the United States on one side and the Dominion government and the provinces of Ontario and Quebec on the other, and so far as I know, there has never been any result from those conferences—no tangible result. It is possible that this time, the conditions are such that some good may be expected, and I hope that this is the case.

Mr. Meehan: Mr. Chairman, I can speak for the past in the state of Pennsylvania in regard to that matter, at least in one instance. Some years ago, an invitation was issued for an international convention or meeting in Florida of the governors of the states, and the governor of Pennsylvania appointed delegates from Pennsylvania to that convention, of which I was one, made it a proviso that there should be no expense, and so on.

Mr. Evans: Would it be possible, for the original steps to be taken by the administration in Pennsylvania? If this invitation merely proceeds from this society, as a scientific body, it might not have the same practical results in weight as if it proceeded from the commonwealth of Pennsylvania.

Mr. Meehan: Of course I cannot answer that question very well; but I would be very glad, if this society desires to ask the governor of the commonwealth of Pennsylvania to issue an invitation of that kind to present the request to the governor of the state. But of course, I cannot answer as to what the outcome of that would be in this instance. It is, I think, rather a dangerous procedure to take. Of course if he did it, it would be all right; if he did not, it would in a measure give a black eye to the whole affair, because it would go out that the governor of the State of Pennsylvania declined to issue any such invitation as that, and give the idea that he was opposed to such a thing, whether he was or not.

President: That question came into my mind in saying what I did. Would it not be, on the whole, the most advantageous method to adopt a resolution favoring the calling of such a meeting substantially as the committee reported it, and to leave to the executive committee the ways and means of promoting such a meeting? A large share of the business must be transacted by that committee in any event, and if they find a method that is more advantageous than any other, it seems to me, they should put that into effect, rather than be bound by the vote of the society, which has not had proper time for consideration of the subject.

Mr. Meehan: I think that is a good idea.

President: If there is no objection on the part of Mr. Fullerton or the other members of the Society, it will be understood that the resolution will be amended or changed by the chairman, committing to the executive committee of the Society the arrangement of details and so on for the meeting.

Mr. Fullerton: I have no objection at all to that change. I want something done, that is all I care. I do not want this to

fall into the hands of the executive committee, go along, and then have nothing done.

Mr. Meehan: I think I can speak for the executive committee this year.

Mr. Fullerton: That is good. That is all I want to know.

President: Is there further discussion of this subject? If not I will put the question. Those in favor of adopting the resolutions following Mr. Evans' paper will say "aye," opposed "no."

Resolution carried unanimously.

Mr. Fullerton: Mr. President, I have another resolution I would like to introduce now. I do not like to leave it to the chairman of our resolutions committee, because his ancestors were born in Ireland, and he shares some of their national characteristics, and, with the consent of the association, I will read that resolution.

The resolution is as follows:

Resolved, That the thanks of the American Fisheries Society is extended to the Hon. W. E. Meehan, commissioner of fisheries of the state of Pennsylvania, for the many courtesies extended during our stay in the City of Erie. We want Mr. Meehan to feel that his efforts to make our stay pleasant are appreciated, and the thanks of the Society are hereby tendered Mr. Meehan for his many acts of kindness, in making our stay a pleasant one.

Mr. Fullerton: I move the adoption of the resolution.

Motion seconded.

Question put and resolution unanimously carried.

Mr. Meehan: Mr. Chairman, this comes like an unexpected blow; I am caught in the part where there is the least resistance. I think the resolution was unnecessary. I take an interest, you all know, in the work of this society, and whatever I have done, has been done with my whole heart and soul, and I think I have done no more than my duty, no more than Dr. Birge, no more than Mr. Willard, no more than Mr. Peabody or Dr. Smith or any other member of the society has done, and it seems to me invidious to have selected me from the others for this special honor, for an honor I consider it. I thank you.

President: Is there anything further in this general order of business. If not, we will pass to Mr. Atkins' papers. You have them Mr. Secretary. One on "Foreign Correspondence," and the second paper is on "Salmon Eggs."

Dr. Smith: In the absence of Mr. Atkins, who is the chairman of this committee on foreign relations, and the disability of Mr. Titcomb, who is the next ranking member, the duty of presenting this report devolves upon me, and in view of the length of the report and shortness of our time, I do not intend to read it unless the society insists.

This is a report that abounds in good things, and I feel that the members will get the most good out of it by reading it themselves in the proceedings. I say this because I had little to do with its preparation, and therefore cannot be accused of being egotistical.

I would like to mention one or two features of the report, however, so that you may anticipate what you have coming.

There is a very interesting account of the progress of fish culture in France, based on recent government communications, and this is followed by a special paper by Mr. Titcomb giving his personal observations on fish culture in France. A subject that has been creating a great deal of attention on the continent of Europe is the feeding of salmon. That is also a subject in which Mr. Atkins has taken great interest, and you will find in this some exceedingly suggestive points.

Among the subjects treated under that head are, live food for fry, food for fingerlings and yearlings, food for brood fish, and the forcing of the growth of animals by the administration of special kinds and large quantities of food—forcing for market purposes and also for brood purposes.

There is also a very interesting chapter on the utilization of earth worm as food for trout, and it is recalled that Darwin estimated the number of worms in two and a half acres of ordinary moist land at more than 130,000, equivalent to 100 pounds of angle worms to the acre. I may say that these chapters on the feeding of salmonoids represent the latest European opinion on the subject.

There is a point of some local interest that I would like to

mention in connection with the progress of fish culture in Argentina, about which we have heard a good deal from Mr. Titcomb, and other sources. The inauguration of fish culture in our sister republic is attributable to the interest taken by the United States government, and we are therefore gratified at the results. On the occasion of the visit of Secretary Root to Argentina last winter, he was given a banquet in Buenos Ayres, at which American brook trout was served. These fish had been hatched from eggs sent from this country in 1903, I believe. Mr. Tulian, who is national fish culturist of Argentina, writes that the American trout commenced spawning a month earlier in 1907 than in 1906, and up to the 10th of June of this year, he had collected 200,000 brook trout eggs, nearly all from pond fish, as there were no suitable nets for catching the wild fish in the streams. A friend of Mr. Tulian states that he had personally caught, with hook and line, about 200 nice brook trout from little streams which ran through the field near his house, and he further states that his small boys had put a gunnysack across the narrow part of this stream and gone upstream and driven twenty-three nice trout into the sack. They have already adopted American methods down there.

A short time ago Mr. Tulian's men found an eight-inch lake trout on the shores of one of the lakes, and Mr. Tulian states that many of the lakes in the region contain brook trout and lake trout as well as landlocked salmon.

One of the most significant pieces of information that the committee on foreign relations has to communicate, is with reference to New Zealand. Members of the committee are aware of the long-continued efforts of the people of New Zealand to introduce fish into that island, and the success of the planting of rainbow trout among other fishes is well known. The local government has received from the United States government many consignments of eggs, most of which were taken over by Mr. Lambson of our society, and Mr. Ayson, the New Zealand Fish Commissioner, who is one of our corresponding members. Mr. Ayson writes us that the sockeye salmon and the chinook salmon have been successfully acclimatized in certain streams, and that spawning fish have recently returned in large numbers.

The report of the Chairman of the committee on Foreign Relations is as follows:

SECOND ANNUAL REPORT

OF THE

COMMITTEE ON FOREIGN RELATIONS.

In this, its second report, the committee on foreign relations begs to present to the Society interesting matter pertaining to the last International Fishery Congress, held at Vienna, the proceedings of which have been received since the first report of the committee; to the fishculture of France, Argentina, New Zealand, and Japan, and to the important subject of food for fishes under culture, which is treated in a series of subjoined extracts and translations from foreign publications.

The International Fishery Congress at Vienna, 1905.

This Congress belongs to the system organized at Paris in 1900, the sessions of which are now held at intervals of three years, the next session having been appointed for 1908 in the city of Washington.

From the introductory pages of the report of the Vienna Congress we extract portions of the code of rules and the entire program.

Extracts from the Code of Rules.

Purpose of the Congress. The Fishery Congress shall consider all fishery matters of importance and general interest, and submit propositions and memoranda relating thereto, to governments, provincial authorities and other officials.

Membership. The members of the Congress are representatives of governments, members of the permanent International Fishery-Commission, delegates of domestic and foreign societies and corporations, persons invited by the president of the congress, and individuals from any country who can show their interest in this organization, and declare their accession to the Congress.

Organization. The Fishery-Congress constitutes an official member of the series of International Fishery-Congresses and adheres to the provisions of the regulations pertaining thereto establisht in Paris in 1900. The president and general secretary of the congress are to be chosen by the Austrian Fishery Society (Fisherei-Verein). The vice-presidents are chosen by the Congress from among its members.

Means. The financial means at the disposal of the Congress for the execution of its purposes are: grants of governments and local authorities; contributions of members, which are fixt at 10 Kroner ($2.00) each, representatives of governments being excused from these contributions.

Business Methods. The Congress conducts its proceedings in full session and the participants may address it in German, English, French or Italian.

Subjects Considered.

1. Statute-regulation of Fishery matters.
2. International statistics.
3. Tariffs and balance of trade.
4. International regulations to protect the waters against pollution.
5. Recognition of fishery rights in the construction of water-works.
6. Results of scientific research on the following lines:
   a. Hermaphroditism in fishes.
   b. The distribution of the freshwater fishes of Europe, including Siberia.
   c. The nutrition of fishes and the signification of the plankton.
   d. The migrations of the several species of sturgeon in European waters.
   e. The migration of eels, herrings, sardines and sardelles with special reference to their spawning season.
   f. The species of salmon and their migrations.
   g. Results of investigations into the question of determining the age of fishes by their scales.

h. Observations on the spawning season of rainbow trout.

i. The value of fish as food.

7. International organization of biological research, and the fundamental principles governing the erection of biological stations.

8. Fishculture:

a. Cultivation of freshwater fishes in open waters.

b. Pond-culture.

c. Cultivation of sea-fishes.

d. Cultivation of crawfish.

e. Cultivation of oysters.

f. Cultivation of ornamental fishes.

g. Fishways.

h. The introduction of foreign species of fish.

i. Cultivation of fishes and other water-products in Japan.

9. Diseases of fish.

10. The crawfish pest.

11. Instruction in fishery matters.

12. The training of professional fishermen.

13. Scheme for the organization of professional fishermen.

14. Societies in the fish trade.

15. Transportation.

16. The fish trade:

a. Means of increasing consumption.

b. Regulation of markets.

17. Use and abuse of the drag-net in small bays.

18. Sport-fishing in its relation to commercial fishing, fishery economy, political economy, popular recreation and popular education.

19. Motion introduced by delegate Dr. Fankhauser of Switzerland relative to the collection and publication of international annual statistics of the catch of salmon in the Rhine and other rivers tributary to the North Sea and the Baltic.

The report of these transactions forms a volume of over 400 octavo pages and constitutes an exceedingly valuable contribution to the literature of fish and especially of fishculture. With

the exception of a single paper in French, all the proceedings are in German.

Among those taking part in the proceedings were representatives from Australia, Baden, Chili, Denmark, Finland, Germany, Holland, India, Ireland, Italy, Persia, Roumania, Russia, Sweden, Switzerland, Spain, United States of American, Wurtemburg.

The representative of the United States was Dr. H. M. Smith of Washington, whose name also appears in the list of vice-presidents.

Fishculture in France.

France has been styled, with some show of reason, the "birthplace of fishculture," meaning by this, of the artificial fishculture which is now applied to the salmonidae, and to a more limited extent to some other families of fishes. Though the possibility of artificially impregnating fishes' eggs and allowing them to hatch under human care was discovered in Germany at an earlier date, it seems to have been two French fishermen, Gehin and Remy, who first, early in the last century, perceived the possibility of employing the process for the benefit of the fisheries, and undertook to apply their theories by actually hatching fish and turning them out in open waters; and when one thinks of the beginning of apparatus for fish-hatching the name that comes first and most prominently to his mind is that of Coste, French professor who devised the apparatus known by his name.

France has not maintained her lead in this field, tho the natural conditions are in some respects unusally favorable. To state the present condition as it is viewed by one of her eminent public men, we may quote the language of Mons. Jules Mercier before the Chamber of Deputies on occasion of the consideration of the question of appropriating money for the use of a hatchery, in December, 1906:

"France is a country of rivers: there is no other nation more richly endowed in this respect. We have 275,000 kilometers (173,000 miles) of rivers, streams, brooks and canals. It would seem that under conditions so favorable we ought to be in position not only to provide for our home consumption, but to export fish to neighboring nations. It is not so however. The fact

is the opposite, and each year we are obliged to buy from abroad seven or eight millions of freshwater fish. Thus we pay a heavy tribute to the stranger,—to Germany, to Belgium, to Holland, who are our suppliers. It is a situation that ought to be remedied, as each year our water-courses are getting more barren."

M. Mercier's further remarks illuminate the situation so much that we continue the quotation:

"What are the causes?

"These causes the minister of Agriculture has clearly defined in his remarkable report on the budget of agriculture in 1904, together with the remedies.

"Of these causes, some may be abated, others should be suppressed,—and among the latter we point out especially the depopulation of our water-courses which is practiced with the use of various substances, especially the berries of *Coccus Indicus*.

"It is necessary to regulate and even suppress the use of coccus berries, and to punish with the utmost rigor the public malefactors who employ such and those who use lime and dynamite, which are equally efficient means of destroying the fish of our rivers.

"Further, there is one point on which all the world is in accord;—that is, that to repeople our water-courses it is necessary to resort to artificial reproduction. That is fully understood by the Direction of the Forests. Charged in 1897 with the service of fisheries, it has made the most laudable efforts, and established several stations. Many departments and communes have followed its example. Finally, private initiative has worked wonders: it has founded numerous fishery societies. Of these societies, which numbered 150 in 1898, there are today 600.

"But all these stations, whether public or private, are wanting in the essential for success,—they lack brood fish. They are obliged to obtain abroad, especially from German sources, from stations in Baden, Saxony and Wurtemberg, the millions of eggs that they handle. What we need is a grand station of fishculture which can furnish gratuitously to our fishery societies and the other stations belonging to the state, to the departments and to the towns all the eggs that they are now obliged to get in Germany.

"We had constructed the station of Bouzey, but Bouzey has

disappeared by the bursting of the reservoir of the canal of the East.

"The station of Thonon, for which we ask a subsidy of 20,000 francs, has given remarkable results. The minister of Agriculture was pleased to visit it two years ago, and he noted its importance and the excellence of its management.

"This establishment, with a modest appropriation of 3,000 francs, now produces five to six millions of fry, which it distributes in the neighboring departments. It thus supplies excellent products to all this region, seven or eight departments. It further furnishes to other stations of the state and to the hatcheries of towns and fishery societies seven or eight hundred thousand eggs in the best condition.

"The grant of 20,000 francs which we ask for is a pretty small sum in comparison with results that we can achieve.

"The station of Thonon is situated on the shores of Lake Leman, that is, of a reservoir of 58,000 hectares (224 square miles) abounding in fish. It can develop itself without expense on lands which belong to the state. Finally it possesses springs of marvellous purity.

"Today we are allowing ourselves to be outdone by other nations. Thus, alongside of us Switzerland, a country one-tenth of our size, puts into its budget an appropriation of 25,000 francs for fishculture; and all the cantons of Switzerland vote special subsidies for the same object;—the canton of Zurich, 6,000 francs; the canton of Vaud, 5,000 francs, etc. Other nations give us an example still more striking. In the United States two millions (francs) are appropriated for fishculture; in Japan, one million; in England and Germany large sums are devoted to this object. In the latter countries the work of fishculture is carried on by the fishery societies by means of the large grants that are accorded them."

The discussion following these remarks (which are not given in full) was participated in by several members of the chamber of deputies and by the minister of Agriculture. Amongst other facts brought out were the following: there are three principal fishcultural stations, that of Nancy, that of Thonon and that of the University of Toulouse. At these stations they produce solmonoids, cyprinoids and crawfish. It seemed to be the general

opinion that the disappearance or decrease of fish in the rivers of France was due mainly to the pollution of the waters by industrial refuse, but that there was hope of a remedy.

The Minister of Agriculture summed the matter up in these words. "As concerns existing manufactures, the interministerial commission of fish and the commission of scientific studies appointed in connection with the hydraulic service is engaged in researches as to the best means of regulation and of purifying residuary waters turned into the water-courses. Thanks to the work of eminent savants, we shall soon reach this point of finding out easy processes of purifying sewerage and industrial waters, and the day when scientific methods will permit us, we shall do away with that constant source of contamination. It is a matter of national concern to put a stop to the turning of industrial waters into our rivers, not only on account of the disappearance of fish, but beyond that and above all, on account of the public health."

The appropriation of 20,000 francs was voted by the chamber, but with the condition that it should be divided among the three establishments: at Nancy, at Thonon and at Toulouse.

Altho the river fisheries of France are at a low ebb in comparison with their former condition of productiveness, they are by no means exhausted. Even of salmon, those rivers discharging into the North Sea and the Atlantic, which drain nearly nine-tenths of the area of the country, and which alone were naturally frequented by salmon, are still annually producing, we are told, salmon valued at about a quarter of a million of dollars, —a large sum, but, it is claimed by some writers, little more than a twentieth part of what those rivers are capable of yielding.

Besides the three fishcultural establishments named above, there are 68 others belonging to municipalities and 58 to private parties. Among the former may be counted the aquarium of the Trocadero in Paris, which has done as a side-issue a good deal of fishcultural work, with the following species: California salmon, carp, tench, guene, roach, bream, eels, pike, gudgeon, bitterling, stickleback; some of these being of course propagated only for ornamental purposes, but a great many fish were placed in open waters for eventual food purposes. An idea of the species cultivated by other parties may be obtained from the

advertising pages of Le Pecheur, which, during the first six months of 1907 contained the advertisements of six establishments located in France offering eggs or fish for sale and specifying as follows: European brook trout, rainbow trout, and American brook trout are each specified by three parties: carp, tench, roach, chub *(Idus melanotus)*, perch, catfish *(Ameiurus nebulosus)* and calico bass, each by two parties: Scotch trout, steelheads, salmon-trout, lake trout, loach, gudgeon, pike and pike-perch, each by one party. It is interesting to note the position of the five American species included in this list. All these stations supply either eggs or young fish, or both, for planting in open waters.

Of institutions for the rearing of fish to be sold directly to the food-markets and consumers there is, so far as our information goes, but one in France, located near Paris: this is the subject of a sketch below, drawn from the personal observations of a member of the Committee on Foreign Relations.

Fish Cultural Observations in France.

(By John W. Titcomb.)

While in Paris I visited the Aquarium to learn what I could from the director who could not talk English. The Aquarium is very poorly supported financially, and the director is unable to do very much in the way of progressive work. The water supply is from the Seine, and also from the Avre. The latter furnishes cold water for trout. The director claimed that he had kept brook trout in the Aquarium for six months in a water temperature of from 26 to 27 degrees centigrade (79 to 81 degr. Fahrenheit). This I claimed was impossible, and in conversation with a fish culturist, after talking with the director, he claimed that the information which I obtained was unreliable. In the Aquarium were some hybrids, a cross between the lacustras and Loch Leven trout. The fish were two years old and weighed 700 grams (1½ lb.). There were a number of fine Quinnat salmon of various ages and the director informed me that he had obtained eggs from four-year old Quinnats when they weighed two kilos (4½ lbs.) each, and successfully reared the product of such eggs for making up his exhibits. He was under

the impression that rainbow trout required a lower temperature than the speckled trout. When it is necessary to aerate the water he pumps air of a high temperature into the cold water. I merely raised the question about aeration because it occurred to me that possibly some of the trouble from aerated water occurred from pumping hot air into cold water.

After visiting the Aquarium I hired an automobile with the intention of visiting a commercial trout hatchery, said to be the only one in France, situated near Cernay la Ville. The owner of this hatchery is H. Callier. The automobile broke down however, and wore on my nerves and I returned to Paris without seeing the hatchery. I talked with the owner, however, who gave me the following information. Besides selling more or less fry and fingerlings, he produced for market 100,000 trout per year on a water supply of 100 liters (26 gallons) per second. These trout when sold weighed from one-fourth to one-third lb. His pond system covered a water area of 15,000 square meters (near 4 acres), divided into 54 ponds. The fish were fed on an inferior species of sea fish and horse meat, and at the time of my contemplated visit he was feeding about 180 kilos (400 lbs.) per day of this kind of food in equal proportions. The food cost him about 12 francs per 100 kilos (about 1 cent per lb.). The highest water temperature during the summer for one month ranges at about 22 dgr. centigrade (71½ F.). He sorts his fish and cleans his pond three times a year. The young fish he feeds with liver once or twice a day. He claims he starts with 300,000 eggs in order to make 100,000 marketable fish. In other words he raises to marketable size from eggs 33 1-3 percent. The head reservoir which is the source of water supply for all of the ponds contains 800,000 square meters (200 acres) of water. Most all of these ponds are long and narrow, the longest one being 55 meters (180 feet). When transporting live fish, he places two kilos (4½ lbs.) of fish in 60 kilos (132 lbs.) of water in the summer time, and in cold weather for ordinary distances, 4 kilos (9 lbs.) of fish to 60 kilos (132 lbs.) of water. The market price of trout thus raised averages about the same as it does in this country, namely, 50 c. per pound, which in comparison with the low rates of food stuffs in France really is much higher than the market price here. He confines his work entirely to the pro-

pagation of rainbow trout, claiming that his water is not cold enough to successfully rear speckled trout.

The Salmon Question in France.

(From the London Field, Dec. 30, 1905.)

In old times salmon were plentiful in Normandy, Brittany, in all the streams of the basins of the Loire, Gironde, Adour, except, strange to say, in the Rhone and its tributaries, where the fish, so far as historical record goes, seems never to have existed. So late as the end of the fifteenth century salmon was sold daily in the markets, fresh as well as smoked, and up to the end of the eighteenth French laborers stipulated (just as, it has been shown, apprentices in England did) that is should not be given them for their dinner more than thrice a week.

Unfortunately, these halcyon days are long gone by, and it would be difficult to imagine anything more desperate than the present destitution of these waters, which were formerly so rich. Their decline is, no doubt, in part to be attributed to many of the same causes that operate in the United Kingdom, and among them may be mentioned the increase of the population, the development of communications, and the progress of agriculture and industry. There are, however, two other causes, special to France only—the Inscription Maritime and the indifference or neglect of Government and public powers.

The Inscription Maritime is nothing more or less than the national reserve of France for its combative and merchant navy. It was established by Colbert in the time of Louis XIV, in order to supply the fleets of his country with an adequate number of sailors, and as the population of the coasts was not sufficient, then, for the purpose, the astute minister conceived the idea of adding a number of fresh-water fishermen to the regular seamen of the littoral, men who lived not only on the estuaries, but also on the banks of the rivers themselves, sometimes even a very long distance inland. The system has been carefully maintained and kept working ever since, especially under Napoleon I, and though there is at present so great a surplus of "inscrits" that about 60,000 of them are never wanted, there is no likelihood that the Government will ever think of suppressing or changing the meas-

ure. As every inscrit has a right to fish, with net and coble, without paying any fee, and as there are, in fact, scarcely any limitations to this privilege, one may well imagine the results. The Normandy salmon, formerly so abundant, are nearly extinct. In Brittany, where up to a hundred years ago they still were more than abundant, there are now few rivers in which the fish is still to be found. In the Gironde and its tributaries salmon are now a rarity, while in the district of the Loire itself (the area of whose basin amounts to no less than 8000 English miles) the yield has fallen in the last fifteen years to such an extent that the proportion now is but one to twenty then.

The French Government, no doubt, is largely responsible for this state of things. Before 1897 inland fisheries were under supervision and control of the Ponts et Chaussees Department. After that date they passed into the hands of the Department of Forests. On the whole, one may say, the change did not prove altogether successful. To the foresters, just as to the engineers, piscatorial matters remain a secondary part of their business, and therefore receive from them little or no attention. And experts say that so long as a special fisheries department is not created in France, there is not much hope for the better management of rivers.

Politics have also sadly interfered, as usual, in the question. France is the land of universal suffrage, and this suffrage has always had a strong inclination to regard all matters not from the standpoint of general but of private and local interest. And as in fishery matters it is impossible to promote the one without infringing more or less on the other, it follows that Parliament has always shown itself not at all anxious to discuss these matters anew, the more so, perhaps, since the great majority of its members know nothing about them. Amongst the French Radicals, also, there has been, and there is still, a strong prejudice against shooting and fishing rights, which are considered more or less as remnants of the feudal system. For these reasons the fishery question has played a very small part in the preoccupations of both chambers since 1829, in which year was promulgated the law that is still the basis of fishing and angling regulations in France.

Some change, however, has been of late happily noticeable

in the situation, owing to the pressure of a few enterprising people, who are better aware of the disastrous consequences of the state of things prevailing on the rivers. For some six or seven years a movement has been started that is daily gaining ground, and that has begun to tell on public opinion. In England, there is no doubt, the better preservation of salmon has been due in great measure to the presence and to the efforts of a mighty body of salmon anglers. France, however, has never been able to rely on any such assistance. Salmon angling is, in fact, so little known in France, or practised in so very few places, that it interests practically only a small minority. Up to the last two or three decades, angling was not much in honor amongst French gentry, who preferred the gun and the whip, and left the rod somewhat scornfully to the lower classes. Even they for a long time never dreamed about the possibility of capturing the noble fish by hook and line until the practice was imported into Brittany by British residents, some fifty or sixty years ago. And even there, with a few exceptions, salmon angling has never been carried on except in a sort of pothunting and unsportsmanlike fashion, by people whose sole object was the profit which they could derive from it, and who were totally unable, by position, short-sightedness, or ignorance, to understand the importance of the salmon question, or to view it on the broad lines on which it ought to be considered. Everywhere else the situation is still worse, salmon fisheries being mostly in the hands of inland netsmen, whose motto was always and is still equivalent to destruction.

The starting of a movement for the preservation of salmon was therefore, in such circumstances, particularly difficult, there being, in fact, but one large corporation interested in the matter, the Inscrits Maritimes of the estuaries. Their mental attitude was no better than that of the netsmen, and their action was always exercised in the most dangerous way. It would take too much space to give here an account of their various and incessant efforts to obtain increased privileges and to get rid, by degrees, of the last few restrictions that afford, nominally, a semblance of protection for the salmon and other migratory species (shads, lampreys, &c.). Suffice it to say that, up to 1899, far from meeting with any counter-party, they were the object of unceas-

ing Governmental favors, several inquiries on the question having been always conducted with a view to giving their claims satisfaction.

It is only since the said year that some resistance has begun to show itself against their ever renewed encroachments. Owing to the initiative of some men of position (among whom may be mentioned M. du Saussay, Conseiller General d'Indre et Loire; M. Herault, President de Chambre a la Cour des Comptes; MM. Audiffred, Gacon, Pauliat, senators; MM. Peronneau, Petitjean, Defumade, members of Parliament; M. de Paulze d'Ivoy, a diplomat formerly attached to the French Embassy in London), the twenty-four Conseils Generaux of the Loire basin appointed a committee to inquire into the actual state of inland fisheries in general, and of salmon fisheries in particular, in the said basin, and to promote the adoption by the Government of the different measures that would be recognized as necessary for bettering the said fisheries.

The committee, which numbers no less than sixty-nine members, all of whom are either senators, deputes, or conseillers generaux (something, *mutatis mutandis,* like county councillors), met for the first time in April, 1899, and have held since (an unprecedented record for Parliamentary commissions) some twelve or fourteen sittings, at Poitiers, Tours, and Paris. A very long program has been elaborated, the principal points of which are the following: Suppression of Inscription Maritime on the estuaries and lower reaches; suppression of fixed engines; addition of private members to the already existing formal Commission de la Peche fluviale, in the Department of Agriculture; concentration of all fishery matters for the twenty-four departments of the Loire into the hands of a special Government commissioner; removal of all obstacles to the ascent of fish towards the upper waters; and the putting up of fish passes, &c.

At first the commission met with the Government's best will; MM. Mougeot and Ruau especially (the present and the former Ministres de l'Agriculture) had no words gracious enough to emphasize its merits. It did obtain some important results. A stop was put to the excesses of Inscription Maritime; sundry abuses were reformed on several important wiers on the Vienne and the Creuce, and an inquiry was ordered for the enforcement

of the law of 1869 concerning free passage. But as soon as the agitators insisted on a further application of their other resolutions they were then secretly opposed by all the combined forces and by the traditional red tape of the Agricultural Department. The department greatly resented their initiative, was horrified by their audacity and nearly lost its temper at the possible necessity of having to awake out of its pleasant inactivity. Therefore, instead of facilitating the committee's work, the department employed every device that might wear out its energy or discourage its efforts. The committee's case, however, is fortunately so good, and its members are so strong, as to exclude the possibility of a final check. Public attention has at last been aroused, and is not likely to permit so important a question to be shelved any longer. There can, in fact, be no doubt that in due time the committee will get the best of this strange and unexpected conflict, to the great advantage of the Loire and the welfare of the district, for which the salmon fisheries represent a considerable interest, if it is true, as the committee thinks and asserts, that the annual produce of salmon, which for the Loire basin only amounts still to some £50,000 or £60,000, ($243,500 or $267,850) could be easily advanced to £1,000,000 ($4,870,000) yearly.

Fish Cultural Progress in Argentina.

Our enterprising sister republic at the extreme southern end of the western hemisphere has reason to be gratified at the results of the recent introduction of American fish and fish culturists, of which the Society has been duly informed. On the occasion of the visit of Mr. Root, Secretary of State, to South America last winter, he was given a banquet in Buenos Aires at which American brook trout were served. These had been hatched from eggs sent from this country in 1903, as already noted in the Proceedings of the Society.

Mr. E. A. Tulian, national fish culturist, writes that trout commenced spawning a month earlier in 1907 than in 1906, the first eggs being collected on April 27. June 10 he had collected over 200,000 brook trout eggs, nearly all from pond fish, as there were no suitable nets to catch the wild trout from the streams. Within a day or two after the date of his letter, it was expected

140,000 eyed eggs would leave the lake for Buenos Aires, whence they were to be taken to La Cumbre and hatched in a temporary plant erected at that point.

Mr. J. A. Jones, of Nahuel Huapi, tells Mr. Tulian that during the past few months he has personally caught with hook and line about 200 nice brook trout from the little stream which runs through the field near his house, and says they are the finest he ever tasted; he also states that his small boys, who had put a gunny sack across a narrow part of this stream, went upstream and drove 23 nice trout into the sack. A short time ago one of Mr. Tulian's men found an 8-inch lake trout on the shore of Lake Corrintosa, and Mr. Tulian says there is every proof that many of the lakes in the Nahuel Huapi region contain brook and lake trout as well as landlocked salmon.

American Fishes in New Zealand.

Members of the Society are aware of the long continued efforts of the people of New Zealand to introduce American fishes into that colony, and the success attending the transplanting of the catfish and the rainbow trout. The local government has been particularly desirous of acclimatizing our salmon and whitefish, and has received from the United States government many consignments of eggs, most of which were taken on their long journey by Mr. G. H. Lambson, of our Society, and Mr. L. F. Ayson, the New Zealand fish commissioner, who is one of our corresponding members. Under date of May 30, 1907, Mr. Ayson has written us as follows in regard to recent developments, which are of a decidedly interesting nature:

You will be pleased to hear that we have had a run of both chinook and sockeye salmon up spawning this season. You are probably aware that we had a run of spawning chinook salmon in the Waitaki river and its tributaries last season. We discovered them early in May and with the exception of one female fish all the others we were able to capture were spent fish. I am of the opinion that they went up in March and April. This season at the same time we find quite a good run of them again.

The only sockeye eggs imported into the colony were brought over by Mr. Lambson in 1902. Most of the fry which were

hatched out from these eggs were planted in streams which come down from the snowy Southern Alp Mountains and flow into the head of Lake Ohau. Three years after planting reports came down from the manager of a sheep ranch in that territory that a school of fish were spawning in April, and quite a number of dead fish were about. We were, however, unable to obtain a specimen and verify the report. About the middle of April this season fish made their appearance again. The same man went out to the nearest telegraph station and wired to me that a large school of fish were up, that quite a lot of dead fish were about, and that he had 14 caught and enclosed in a pool. I at once sent the manager of the Hakataramea government salmon station up, and he found quite a lot of fish about—a good many dead, and all the others which he handled were spawned fish. They were sockeye salmon all right, and fish running from 3½ to 6½ pounds in weight. Our manager brought 6 specimens down for identification and they stood the test, Sir James Hector and other authorities pronouncing them to be sockeye salmon. These fish are the progeny of the fish planted in 1902, and we may take it for granted that they are estableshed in our waters.

Lake Ohau is one of the branches of the Waitaki River and, as I have indicated in this letter, it is fed by rivers which come down from the snowy mountains.

With regard to whitefish, next summer I purpose netting the two lakes which we have been trying to stock with them. I feel pretty confident that we will take some good whitefish in the nets.

Fish Culture in Japan.

The Bureau of Fisheries received through diplomatic channels a request for a consignment of rainbow trout eggs for the imperial preserves at Nikko, Japan. The eggs, 87,500 in number, were supplied from the Leadville station and shipt in June, 1907, from Seattle to Yokohama.

The most important branch of fish culture conducted under government auspices in Japan is salmon hatching. The hatcheries are in northern Japan, and the work is addrest chiefly to the dog salmon *(O. keta)*, the most abundant species, the catch of which amounts to about 3,000,000 fish annually. Until a few

years ago, the catch had remained about the same since 1892, exhibiting a slight decrease. Recently, however, the output has been increasing, and this is attributed to artificial propagation. There are now 28 salmon hatcheries, which liberate 35 to 40 million fry annually. In the opinion of Dr. T. Kitahara, of the Imperial Fisheries Bureau, who in the fall of 1906 made a special inspection of the salmon hatcheries and fisheries, artificial propagation is a least ten times as effective as natural propagation in the case of the dog salmon in Japan.

The Feeding of Salmonoids.

(Extracted from a series of editorial papers published in the Allgemeine Fisherei-Zeitung in 1906-7, under the title, "First Introduction to Feeding of Salmonoids."

Live Food for Fry.

The feeding of the fry is the most difficult task that the fish-culturist has to master. In this work we are confronted by the same dangers with which we have to contend in the nourishment of our own sucklings, which, as is well known, when other foods are substituted for mother's milk, die in multitudes, of intestinal catarrh or other diseases. If we are going to make use of our experience in the feeding of infants, then we must demand:

First, that the food shall be administered always and only in irreproachably fresh condition; *second,* that the food shall be given only in an easily-digestible form; *third,* that the chemical composition of the food shall meet all the numerous demands for the building up of its blood and various tissues.

Beyond question, live food meets all the above demands. In nature the young salmonoid fry feed on microscopic animals, such as insect larvae, that is, larvae of ephemerids, of caddisflies, of mayflies, the larvae of certain gnats, for example the kriebel-gnat, also on small crustacea, especially young amphipods ("Flohkrebschen," doubtless meant to include Gammarus and other amphipods) and other minute creatures, which are found on the plants in trout-brooks, between stones on the bottom and on the shore.

Were we in position to furnish the young fry a sufficient

supply of this natural food, the problem of fry-feeding would be solved. But in spite of all the numerous attempts which have thus far been made to breed natural food in an artificial way in considerable quantities, no one has yet got to the point of having this food in sufficient quantity available at all times. Still, this food plays such an important part in fry-feeding that we must speak of the methods of its production.

For the feeding of salmonoids, without doubt the artificial culture of amphipods *(Gammarus &c.)* stands at the head. For of all living food-animals that are to be considered for trout and their relatives, the amphipods are least dependent in their reproduction on temperature, and can therefore be bred in winter or in the cold spring months.

The common amphipod (Gammarus pulex is doubtless meant) has, as an inhabitant of cool trout-brooks, become so adapted to low water-temperatures that it reproduces at all seasons of the year To propagate them on a large scale the best way is to lay out small ditches not over one meter (39 inches) wide and 20 to 30 centimeters (8 to 12 inches) deep, with pools a meter square here and there, say every 5 meters (15 ft.) These ditches are to be thickly planted with water-cress and have a strong current of water passing thru them.

Amphipods are fond of flesh-offal. So, small morsels of finely cut slaughter-house offal are thrown into the ditches, with care against excess, since any considerable development of putrescence must be avoided. The amphipods of the trout-brooks have great appetites for oxygen and do not well stand water that is polluted by putrescence and poor in oxygen.

These ditches are stockt with amphipods from a trout-brook where they have been collected with a dipnet. Here, after a while they will multiply so enormously that a great deal of fry-food can be taken out. Of course, for the fry only the very smallest young amphipods can be used. So the contents of the net with which they have been dipt from the ditches must be strained thru a wire strainer thru whose meshes only the young amphipods, the size of one millemeter (1-25 inch), can pass if they are to be fed to the youngest fry.

With the growth of the fry one can, conformably with nature, also feed the somewhat older and larger specimens, while the

full-grown amphipods are better fitted for the fingerlings and yearlings.

There are establishments that have engaged in this kind of amphipod culture on a large scale and feed all their fry and even their yearlings exclusively on amphipods. Wherever, in the neighborhood of a hatchery there are natural ditches with currents of cool water, there are usually, under natural conditions, so many amphipods that it pays to search them well as the trout-brooks, for food for fry.

However, the construction of such breeding-ditches is not everywhere practicable, and the hunting up and the straining are time-consuming and fussy operations. Much as amphipod culture is to be recommended, however, one will, alas, generally fail of success for the reasons named.

Really more dependent on external conditions than amphipod-culture is the breeding of daphnids and copepods, those minute, almost microscopic crustacea which in point of size would be especially fitted for consumption by young fry. These creatures occur naturally in trout-brooks only in small numbers, since they in general demand a higher temperature. They are plenty in our waters only during the warm season of the year and they reproduce abundantly only at that season, passing the cold winter months mostly in a state of rest.

The only exceptions to this rule are in the cases of large, deep lakes that do not freeze over in winter, where the species named are to be found the whole year thru; altho, even here, they occur very sparingly in winter. Whoever is fortunate enough to live in the vicinity of such lakes can at any time get these animals for fry-food, by fishing with a fine gauze net. The best time is in the twilight, say about an hour after sunset; for the crustacea mentioned have the habit of collecting in swarms at the surface of the water at nightfall, whilst during the daytime they scatter in the depths. Catches made in the twilight are therefore far better. In lakes that freeze over in winter one can count on a good catch only from May on, that is, when it is for the most part too late for the rearing of fry.

The artificial culture of daphnids and copepods has been often practiced. The process consists in laying out small ponds of about 2 square meters, (22 square feet) and one-half or two-

thirds of a meter (20 to 26 inches) in depth, strewing the manure of various animals on the bottom, spreading a hand-depth of garden earth over this and with a gauze net transferring to this pond the mother crustacea from any pool or pond. From the manure many protozoa are developed, also unicellular algae, which serve the crustacea for food, and when the water in the ditches is well warmed up, say up to 20 degrees, and higher (77 Fahrenheit and upward) the development of the crustacea may become so rapid that in a few weeks the water of the ditches straightway swarms as with a living soup, and affords a rich booty.

But, as already noted, the rate of reproduction of these animals depends so much on the temperature that it is not possible to get daphnids in this way in great quantities so early as February or March. It has therefore been recommended instead of ditches in the ground to use petroleum casks in a similar way and set them up in stables where the temperature is even; but here the yield corresponds with the narrow space in the casks and is a very small one; and the whole process is right fussy. Altogether the culture of daphnids in any method yet devised has not come into general use; and so it will remain in the future, unless some one succeeds in finding daphnids that with good nutrition reproduce rapidly in confined quarters during the cold months.

What we have said about daphnids and copepods applies also to insect-larvae. These also multiply enormously in artificial pools that are drest with manure, but only during the warm months, and in especial abundance only so long as sunny weather prevails. The reason for this is that insects swarm freely and lay their eggs in water only in sunlight, while in cold rainy weather they crawl away.

Artificially bred insect-larvae, among which we have to count fly-maggots, cannot be had in quantities in the early months of the year, when we are in especial need of fry-food. But on the other hand, in the rearing of yearlings of which we shall here speak later, the breeding of maggots plays during the summer months a more important role.

From the foregoing discussion the conclusion is drawn that we can at any rate under favorable conditions in some places

produce amphipods for fish-food at the proper time and in satisfactory quantity. But as to the other food-animals that come into this question, they cannot be had in quantity until it is too late for fry-feeding. Under present conditions therefore we are imperatively referred to artificial food when the problem is to feed a somewhat larger number of fry.

Food for Fingerlings and Yearlings.

Doubtless live food is best, and those establishments which have a specially favorable location, that is, in a region where, on account of the mild climate and fertile soil, natural food exists in large quantities, of which, in particular, insect larvae form a chief part, undoubtedly thrive best when they reject artificial foods and maintain their stock of yearlings on natural food.

This sort of rearing may be much helped by introducing in quantities, living natural food, which, according to the situation, may be collected from brooks or produced in special pools. It is to be especially noted here that for this purpose, the common fresh-water shrimp, (*Gammarus pulex*), may be collected in quantities and introduced into the ponds from small ditches leading from trout brooks and well stocked with water plants. Here, too, these shrimps are able to increase abundantly among the plants, if they find the necessary food, so that if a brood stock of them is once established a succession of them is assured, even when the ponds are more crowded.

Further, the artificial introduction of snails into ponds is of great importance. The fittest for this purpose are the small and middle-sized Limnaeas, which are found in trout brooks in quantities, on plants and on the bottom, and which may be easily gathered with a dip-net and transferred to the ponds. Here they often increase so that they cover the entire bottom. If these are not directly eaten by fish in their first summer or first year (because in mature form they are usually too large) their eggs as well as the young snails furnish an excellent trout food. Then too the snails are an especially good means of disposing of the excrement and food-waste on the bottom of the pond. Snails kept in numbers are desirable for keeping fish ponds clean, as they are also chosen and kept in aquariums for this purpose.

For food for yearlings it is possible to produce in quantities artificially and introduce into the ponds a whole list of other living creatures.

In the first rank stands the artificial production of fly-larvae. These are produced most simply by setting on a stake about 20 inches above the water, a box open on the under side and having a wire-cloth bottom 3 or 4 inches from its lower edge. On this bottom are laid offal, pieces of dead animals or any kind of carrion; the flies are attracted by the smell and come and lay their eggs here, and the larvae, as they develop, fall into the water and are eagerly taken by the fish. In producing maggots in this way care must be used lest on warm days too many develop, while on cold ones, the production may cease altogether. In the first case, if more maggots are produced than the fish can consume, the maggot-yielding meat must be taken out of the box for a while. To lessen the smell nuisance, it is well to have the maggot-box tight, with only small holes to admit the flies.

In rearing yearlings, the artificial production of daphnids and shrimps *(Gammarus),* which we have already considered, in this paper, plays an important part; for, as the best period of growth for yearlings is in summer, so also, because of the temperature then prevailing, that is the fittest time to acquire a large quantity of daphnids in the ditches where they are produced. In summer, too, the drains and small pools and ponds in the fields generally yield a rich booty of these creatures.

The above-named food creatures, which live and increase in the fish-ponds themselves, are unfortunately not everywhere to be had in sufficient numbers. In particular, many salmon establishments located in wild situations are so poorly supplied with natural food that it is necessary to furnish other food in the ponds. The same necessity exists also in most establishments which undertake the production of large numbers of yearlings in small space, even when the situation would otherwise be favorable,—that is, when the stock is too great for the rich, natural, food supply. In such cases artificial food must be provided. Of the artificial foods to be considered for the rearing of yearlings, are naturally to be mentioned all those which have already been named in connection with fry-rearing; but it must be remarked that spleen, liver and brain, which in themselves would be use-

ful for yearlings, must be omitted on account of their high price, because for yearlings too large quantities are needed. On the other hand, in the front rank and especially to be recommended for feeding yearlings is fresh fish. This is prepared just as already described for fry feeding. Altho fish too commonly reaches a pretty high price, especially in southern Germany, where the transportation of fresh sea-fish during the warm season becomes much more difficult, and where consequently only the cheaper fresh-water fish are available, there is nevertheless no other better food and this is therefore to be placed in the front rank, in spite of increased price.

As a substitute for fresh fish, frog flesh may serve. When it is possible to get frogs in quantities, they are killed, boiled, and, after the removal of the large bones, ground fine, and fed out just like fish. In the same way it may be recommended to collect living land snails of all sorts. If these have shells, the shells must not get into the food, because splinters of shell generally are as sharp as glass, and might injure the intestines of the fish. To remove the shells the snails are thrown into boiling water, where they immediately die, and may then be easily pulled out of the shell.

If it is not possible to have fresh flesh of frogs or snails always ready in sufficient quantity, as unfortunately will often be the case, it is necessary to have recourse either to slaughter-house offal or to dry foods. The slaughter-house offal, that is, the cheap meat not used for human food, such, for instance, as comes off from the plucks and from the hide, is often employed as food for yearlings, and in this way: it is first cooked and then ground fine with a machine and thrown directly to the fish. This food has not, however, been always approved in the rearing of yearlings. It is asserted that from its use serious intestinal diseases appear among the young fish and it seems that this offal is too indigestible for them. It happens that much slaughter-house waste sometimes comes to be fed not entirely fresh, and then severe diarrhea and even a great mortality to the young fish result. The same which has been said of offal applies also to horse meat. This also, like the offal, is, on account of indigestibility, not to be recommended as food for yearlings. Especially is further warning necessary to avoid smoked or salted horse flesh which the young

fish are absolutely unable to bear. Instead of the offal or horse flesh, the dry foods are to be preferred under all circumstances. These, if well and properly prepared, may be employed as a substitute for fresh fish. As to the mode of preparing and feeding them explanation has already been given in connection with fry feeding. We add to that only that among the dry foods the fish-meals are to be ranked first, while, on the other hand, blood-meal which is often considered hard to digest, should be employed less as a food for yearlings than for forcing.

Food for Brood Fish.

It may be stated here as a foundation principle, that brood fish, if they are to produce healthy and strong progeny, must be carefully provided with the best sort of food, with which the fish breeder must be especially careful. It it cannot be doubted that fish grown in free nature and wild waters produce the healthiest offspring, it follows that for brood-fish live natural food is the fittest under all circumstances. He, therefore, who can possibly keep his brood fish in large ponds, in which nature provides the necessary food, does best to omit artificial feeding altogether. There are some fish-breeding stations so favorably situated that the insect world occurs in exceptional numbers in these waters and there lays its eggs, so that the ponds swarm with insect larvae. Here great quantities of brood fish can grow without artificial feeding.

Where nature is not so liberal the breeder may help by introducing into the pond, in quantities, for example, amphipods and snails, which increase there notably and are eagerly taken by the fish. On this subject we have already written more fully under "The Feeding of Yearlings," and also indicated the unfortunately narrow time-limit within which it is possible to secure live food in sufficient quantities.

Unfortunately the majority of pond establishments are not situated under so favorable climatic conditions that they can leave everything to nature. The desire to maintain the most possible brood-fish in a given space and under existing water conditions is entirely justifiable, and the great majority of fish culturists are therefore compelled to maintain and rear even their brood-fish with artificial food.

In such case what foods shall be considered? Fish themselves undoubtedly stand in the front rank, fresh-water fish as well as sea-fish. Where it is possible to obtain cheap fresh-water fish, as for example, lauben, hasel and stromer, (three cyprinoid fishes similar to American chubs, dace and shiners) which on account of their small size, at best can be used for bait and hence in many places, as large lakes and rivers, may be had at 10 to 12 marks per Zentner (¼ cent per pound), it is advisable without doubt to put this food in the front rank.

As a general principle, fresh-water fish must never be fed out living or fresh, but always in the cooked state, because otherwise there is too great danger of introducing a variety of diseases. When fresh-water fish are cooked they usually fall to pieces in the process and may then be thrown direct to the fish as food. Where it is not possible to obtain fresh-water fish in sufficient quantities, or when the price is prohibitory, sea-fish come in, which are carried everywhere, especially from such wholesale fish markets as Geestemuende, Hamburg, and Altona, but which are also to be had in many inland places, since we have already a notable list of prominent sea-fish markets in the interior, from which such things may be transported at a considerable saving of freight charges. All sorts of sea fish may be considered which are too small for human food. In the same way may be used the otherwise worthless heads of the larger fishes. Unfortunately those sea fishes are not to be recommended which are distinguished by being very fat, as especially herring, which are sometimes thrown on the market in great quantities at a very low price, especially near the coast. The fat is very unfavorable to egg production, since in the feeding of brood-fishes, fattening them is to be especially avoided.

When sea-fish are used for food, they also should be offered in the cooked state, in the first place on account of the possible production of parasites, secondly because in feeding heads, the bones must be softened by cooking. In this case, of course, the large bones are to be removed and the small ones, if not cooked up, are to be crusht as well as possible. Sea-fish cost everywhere as much as fresh-water fish, but there is the advantage that they are regularly obtainable and in the desired quanti-

ties. Unfortunately, stations further from the sea are at a disadvantage, because the transportation of sea-fish involves large expense, and because during the warm season, that is, the summer, the fish can only be sent packed in so much ice, that freight charges are too high. But it is impossible to insist too strongly that sea-fish must not be fed out, which are not quite fresh or which betray by their odor the beginning or advancement of decomposition. For it may be counted on with certainty that intestinal inflammations and great loss will follow the use of spoiled sea-fish, and moreover, there is sufficient reason to suspect that by the use of any sort of food which is not fresh, the production of sound eggs and milt is made doubtful. Perhaps the frequently noted degeneration of eggs and milt is to be attributed principally to such not quite fresh foods. Thus even feeding with sea-fish has its limitations, as will be seen, and it must moreover be admitted with regret, that for the feeding of brood-fish we have at present no food material which is in all respects satisfactory and unobjectionable. For if fresh and salt-water fish cannot be used, there remain as a resource only either the dry foods, that is, fish-meal, meat-meal and blood-meal, or the slaughter-house wastes, which however, as will be seen later, in the consideration of feeding for market, all have their faults and deficiencies.

For the feeding of brood-fish snails are occasionally to be considered, that is, vineyard snails, naked snails of all sorts, such as are found in damp woods, and of course, water snails. These are all to be cooked and thrown to the fish without further preparation. If they have shells, they must first be pulled out, which is easily done after cooking; or they should be pounded up fine, shell and all.

Frog meat is also good to use as food for brood-fish. All these and similar foods are, however, unfortunately, to be had only occasionally in sufficient quantity, and play no great role practically.

We see then that foods for brood-fishes are very limited, and mention that many breeders have altogether abandoned the feeding of brood-fish and employ only wild fish for procuring eggs and milt. For European brook trout this position is undoubtedly the right one, and it would be for the rain-

bow trout and American brook trout also, if enough wild fish could be had, to meet the demand for eggs and fry, as well as yearlings of these sorts. Since this is, unfortunately, not the case, all who breed these sorts will be driven to feed brood-fish.

Forcing.

Under this heading may be here understood, not only the feeding by which the fish are driven rapidly, and beyond the usual limits of growth, but also the feeding of fish intended for market. Since this latter has to do with the production of so-called mess-fish, (portionsfisch) that is, fish of an average weight of 100 grams (3½ ounces), the question arises, what food is specially adapted for this purpose?

Here naturally again stand in the front rank the fresh and salt-water fish, which have been already recognized as the best food for brood-fish and for the earlier stages. This food should not be lacking in any forcing establishment when it can possibly be obtained.

Unfortunately there are many establishments which cannot obtain fresh-water fish at a satisfactory price, and the transportation of salt-water fish also naturally ceases in the heat of summer for all such establishments as are remote from the sea; thus nothing is left for fish-forcing but recourse to two foods, —that is, first, slaughter-house waste, and second, the dry foods, that is, fish-meal, meat-meal and blood-meal.

Slaughter-house waste is a food which can be obtained everywhere and always fresh. It comes everywhere at a price not higher than one or two cents a pound, delivered at the station, and five or six pounds of it is required to produce a pound of fish. Slaughter-house waste must be used only scalded, and for this reason, that the digestibility of it is thereby materially increased. Great emphasis is to be laid upon this, because slaughter-house waste is of itself always hard to digest, and makes the greatest demands on the digestive apparatus of the fish. Everything must therefore be done, to do away with this indigestibility as far as possible.

A second precept is that slaughter-house waste, after cooking, must be made as fine as possible; the finer it is, the easier it is to digest. Throwing it into the ponds in large pieces is to

be carefully avoided. From this arise, among the fish, the so dreaded internal inflammations by which many thousands of fish are annually lost.

A third rule is, that from the offal all sinewy parts are to be removed, because these cannot be digested by the fish. The fine chopping which the offal requires in order to be digestible, has one evil result. Namely, when such fine food is thrown into the ponds, it scatters so that much goes to waste and decays on the bottom; in consequence of which the ponds are badly fouled. This disadvantage must be counteracted by all means. The next thing to be recommended is to bind the chopped food together by the addition of rye flour. The proceedure is, to add to the meat about a fifth of its weight of flour, and to cook flour and meat together to a pudding, which, after the cooking, is placed on ice for the purpose of cooling and hardening. Of this pudding, pieces of the size of nuts and smaller, are easily made, which, when thrown into the water, are not immediately washed apart into their smallest bits so as to foul the bottom of the pond.

The second means of preventing the infection of the ponds, is a current of water, as strong as possible. The principle may be laid down that fish-forcing should be carried on only in ponds in which a large water supply is available. The flow should always be at least so great that the water in the pond renews itself in twenty-four hours. Of course in such ponds it is indicated not to draw off the surface water, but rather, by means of a double penstock, (moench), to let the water off from the bottom, so that the waste material from the food and fish-excrement which lies on the bottom may be carried off.

It is plain that slaughter-house waste should always be used entirely fresh, since, as soon as it has begun to spoil, there certainly appear inflammations of the alimentary canal, and consequent heavy losses of fish.

Besides slaughter-house waste, horse-flesh is occasionally used for fish-forcing. The preparation of this follows the same course as has just been described for offal. In the use of horse-flesh, however, great care should be taken, because horse-flesh does not give the fish a good flavor. In consequence of this, the good reputation of an establishment may be seriously injured.

The fish acquires a sweetish taste, with a soft, mushy consistence, and a color running somewhat into green. He who wishes to use horse-flesh, therefore, must do it only occasionally, and in any case, not toward the end of the feeding. For some weeks before their sale the fish must always be fed exclusively with the very best food, in order that the flavor may be the best possible.

Attention should still be drawn to an excellent food for forcing. This is the viscera of fowls, which, especially in the neighborhood of great cities with large poultry markets, may be had in quantities at a very low price. These entrails are very easily digested by the fish, which grow exceptionally fast when fed with them. It should be noted, however, that with these viscera the chicken cholera is usually introduced into the pond system, so that in such establishments and their neighborhood poultry breeding is no longer possible.

Where there is difficulty in obtaining fresh slaughter-house waste at above named prices, nothing finally remains but to use the dry foods, fish-meal, meat-meal and blood-meal. Instead of blood-meal, blood itself may be used, if it can be put in the right form. The blood should not be fed directly in the liquid or coagulated state, because it dissolves too much in the water and causes serious defilement of the ponds. Fresh blood should rather be mixed in advance with about one fourth of its weight of rye flour. The whole mass is then heated in a kettle until it just begins to boil. Hard cooking is to be avoided. After the heating, the pudding just produced is poured out on boards in layers of the thickness of the finger, when it immediately stiffens and may be kept several days. Before feeding, the blood-pudding is put through the meat machine, and formed into small sausage-shaped pieces which may then be thrown directly to the fish.

Blood-meal, too, should not be fed directly, but must likewise be bound together by the addition of rye flour brought into a sticky condition. This is accomplished just as when fresh blood is used; only of course water must be added to make a stiff pudding.

Fish-meal, just like blood-meal, must be fed in the form of a sticky pudding, because otherwise and in any other way, too much of it goes to waste, and decays on the pond bottom. For

this purpose the fish-meal is best mixed with about a quarter part of rye flour, and by the addition of water, cooked up to a stiff pudding which, after cooking, is fed direct. If an ice-cellar is available, it is recommended to put the pudding first on the ice, so that it may become firm. The proceeding with meat-meal is the same as with fish-meal. Only it is to be observed that in this case, when cooked to a pudding with rye flour, the meat-meal should receive the addition of one to two per cent food-lime, (Futter-kalk), because the meat-meal contains too little of the lime salts, which the fish need for making bones. Instead of the lime, fish-meal may be added, if the fish-meal was made of entire fish; in this case it contains enough lime from the bones of the fish. A mixture to be recommended, would then consist of one third fish-meal, one third flesh-meal and one third rye flour, to be cooked to a pudding with the addition of water. Since vegetable meal is less easily digested by trout than meat-meal, it is advisable to use a quarter rye flour instead of a third.

With these foods must fish-forcing everywhere reckon, in practice. What may occasionally offer in the way of waste material, is not generally of great importance.

Utilization of Earthworms as Food for Trout.

(From l'Acclimation, 15 Dec. 1904.)

Earthworms play a pretty large part in the natural feeding of trout, as of almost all other fish, for which these annelids furnish a well-relished food and one which seems to be especially wholesome. In the aquarium at the universal exposition at Anvers in 1894, where were assembled specimens of most of the fresh water fishes of Belgium, the new departure was made of feeding only earthworms to all the varieties thus placed on exhibition, and to this precaution are attributed the fine appearance and perfect health of these fishes, which escaped the sickness and large death rate which are usually severe in the case of fishes transferred widely from free streams to the narrow and necessarily less wholesome quarters of such an aquarium.

For a long time now fishculturists have dreamed of utilizing

as food for occupants of vivaria the earthworms which are everywhere found in great abundance in moist soils. Darwin estimated the number of worms existing in a hectare (2 1-2 acres) at more than 130,000, weighing about 115 kilos, equivalent to about 52,000 worms, or 100 pounds per acre.

It is possible to collect these worms in quantities in the fields at the time of tillage, immediately behind the plow which has uncovered them, and this is what certain growers have done in order to secure living animal food for their aviaries or poultry yards. Since this proceeding was always dependent on the plowing, it has been found necessary to try to find a more practical means of obtaining worms in sufficient quantities. Different systems have been occasionally suggested, but thus far no method has been found giving uniformly satisfactory results. Last summer a very distinguished agriculturist, the Baron Malsen, proprietor of the large establishment of fishculture at Karlstein, near Bad-Reichenhall, Upper Bavaria, attempted a very interesting experiment in the artificial cultivation of worms, with a view to procuring them for food for his trout. The method which he followed was suggested by Prof. Roules of the Faculty of Science, of Toulouse. This was the procedure:

A long trench, about 50 centimeters (20 inches) deep and of about the same width, was dug in the ground; then by means of old discarded boards this trench was divided into compartments of equal size. One of these was left empty and the next two were filled with compost mixed with rotten wood and the materials were heaped up to form a mound as high as the depth of the ditch. The full compartments which alternated with the empty ones were covered with rotten straw and dry leaves loaded with large stones to keep them from being blown away. After a sufficient time to permit the multiplication of the worms, with which they had been previously stocked, the heaps were broken up, to permit the collection of the worms, and in their turn the compartments previously empty were filled with the materials of the demolished heaps, new ones being thus formed, and so on in succession.

Contrary to the usual belief, experience proves that angleworms in order to multiply considerably do not need a great deal of moisture, which would even be unfavorable. Compost made

of swamp soil does not suit them, and in a moist climate like that where this experiment was tried it even seems unnecessary to water the compost heaps, although this would doubtless be useful in dry regions. But the covering of leaves is indispensable, as above described, for a protection from the sun. It may be added that watering with manure-water or urine seems to be favorable to the production of worms.

For nutritive qualities the worms thus obtained seemed superior to horseflesh, butcher's waste, offals, dried blood, etc., commonly used by fishculturists as food for trout, and they seem equal to the coarse fish now used in England for this purpose in many fishcultural establishments.

The collection of the worms requires the alternate demolition of the compost heaps, which means considerable work. Therefore where wages are high, as is the case in upper Bavaria, the production of angleworms although practicable is found to involve an expense relatively worth considering, especially when it is admitted that the return could never be very great. In an establishment of the importance of that at Karlstein, for instance, when the annual consumption of food exceeds 20,000 kilos, earthworms could provide only a relatively small part.

Therefore, even though the result of the trial has not been as complete as it might be, it has not seemed worth while to follow up the production of worms, especially since, thanks to a reduction in railroad rates, the Karlstein establishment can actually procure as trout food coarse fish at a very low price (or about 20 to 25 centimes per kilo) and in quantity which may be called unlimited.

Mr. Malsen nevertheless considers the artificial production of earthworms as food for meat-eating fish worth recommending to a fishculturist who is running a small establishment himself without helpers or laborers, and in a country where course fish cannot be obtained at so low cost as in the region of Bad-Reichenhall. He thinks that gardeners, under-proprietors, farmers, etc., who attempt trout growing on a small scale and aside from their chief occupation, could not find a simpler or more practical means of procuring food cheaply for their fish, than the production of angleworms by the method above described.

The curious fact may be mentioned that Mr. Malsen states

that the labor of finding and collecting the worms may be notably simplified by means of a weak electric current which by help of a wire and a small battery is caused to pass through the worm-filled heaps, especially through their deeper parts. The worms try to escape and come in great numbers to the surface, where the collection becomes easy. It is in this way, finally writes Mr. Malsen, that we should hereafter proceed if we were to undertake the production of angleworms on a large scale, which might happen if, in consequence of an increase in cost of coarse fish by an advance in freight rates, we were forced to seek other food for our trout.

The above report is respectfully submitted by the Committee on Foreign Relations:

CHARLES G. ATKINS,
JOHN W. TITCOMB,
HUGH M. SMITH,
JAMES A. HENSHALL,
F. M. JOHNSON,
H. F. DEPUY.

A paper by Mr. Charles G. Atkins of East Orland, Me., on "Manipulation of Salmon Eggs" was then presented.

Dr. E. A. Birge of the University of Wisconsin, delivered an address on "The Respiration of a Lake," and the subject was discussed.

Mr. Meehan: Mr. Chairman, some time ago, in pursuance of my duties as commissioner of fisheries of Pennsylvania, I did something well within the law, but some people did not like it and called it the high-handed outrage of an usurper. I propose just now to act that role of usurper, and for a few minutes at any rate, depose our president from the chair while I offer a resolution and put it.

Resolution read by Mr. Meehan as follows:

Resolved, That the society express its appreciation of and thanks to Dr. Birge, the retiring president, for his uniform courtesy, and the ability with which he presided at the meetings held in Erie.

Gentlemen, you have heard the resolution. (Applause).

Motion made that the resolution be adopted by a rising vote.

Resolution carried unanimously.

Dr. Birge: I thank you, gentlemen, for this kind expression of your confidence in me. When I said last night that I had taken the presidency with a great deal of trepidation, I spoke only the truth. I am very glad the meeting has been so well attended, and that we have had so much material and such lively discussions. I am even glad that the fry vs. fingerlings proposition came up to enliven us, and I must say that I regret the absence of our constant friend of the carp.

Is there any further business to come before us?

Mr. Clark: Mr. President, as there seems to be a little doubt, I would include it in our report that the address be published.

President: If the business of the society is over, I will call Dr. Smith—

Mr. Titcomb: There are some other papers which have not been read.

President: All the papers not read, it will be understood will be printed.

A paper by J. J. Stranahan of Bullochville, Ga., on "Theory vs. Practical Tests," was presented.

A paper by Robert E. Coker of Johns Hopkins University, Baltimore, Md., on "A Study of the Guano Industry and Fisheries of Peru," was also presented.

Secretary: I would say that it would facilitate the business of the treasurer if the members who have not paid their dues would, after adjournment, step up and liquidate; and also that there are a number of reports of the Ontario Fish & Game Protective Association here that will be distributed if the Association wishes any, and I have a number of last year's reports of the Society, and any one who cares for them can have an extra copy.

President: I will ask Mr. Evans and Mr. Clark to escort Dr. Smith to the chair.

Dr. Smith escorted to the chair by Mr. Clark and Mr. Evans, amidst great applause.

Dr. Birge: It gives me great pleasure, Mr. President, to

turn over the Society to you for the most important meeting in its history.

Dr. Smith: I am glad you did not adjourn before giving the president-elect an opportunity to express his thanks for the unsolicited honor you have conferred on him. I assure you he appreciates it, even if he did not deserve it, and that he will labor for the best interests of the Society. If Commissioner Bower were here I should take revenge for the trick he played on me last night in calling on me to make my remarks.

Gentlemen, I bespeak for the Society and for myself and for the other officers for the ensuing term a continuation of your cordial support and coöperation to the end that our Society may be greatly increased in membership; that it may grow in influence, and that it may become a most potent factor both in America and throughout the entire western hemisphere in promoting the interests and controlling the destinies of our common friends, the fishes.

I hope that during the next year your mental gaze will be directed to the goddess of liberty on the national capitol building, and that you will adopt as your slogan, "On to Washington!"

Down in Washington we have no noble lake on which you can keep your eye, and we cannot compete with Erie in other ways, but we have at our door a river rich in historical associations, and we have been blessed by the wealth of our beloved Uncle Samuel with a number of strong cards about which it is perhaps best to say nothing until the game is played.

I thank you very much for this consideration and honor. (Great applause.)

President: Is there further business before the Society? Mr. Meehan, have you something?

Mr. Meehan: I simply move to adjourn, that is all.

President: Is it seconded that we adjourn to meet in Washington in 1908?

Motion seconded.

Motion carried unanimously.

President: We stand adjourned.

PART II.

SCIENTIFIC PROCEEDINGS

THE NECESSITY OF THE STATE MAKING LAWS FOR THE PROTECTION OF FOOD FISHES AFTER STOCKING WATERS BY THE STATE OR UNITED STATES.

BY OREGON MILTON DENNIS.

Secretary Maryland State Game and Fish Protective Association

To the American Fisheries Society assembled at Erie, Pa.

Gentlemen: That there is immediate necessity for the coöperation of the various states to come to the aid of the fish culturists by the passage of proper laws for the protection of food fish after their propagation and distribution in the waters is, I think, admitted by all. The whole scheme of fish protection, primarily, is first to protect the parent fish during the spawning season, and then to protect the young until they arrive at sufficient age and size to be used as food. As is well known, every device that the brain of man can conceive of, has been brought into use to take the largest number of fish, without regard to size, with the least possible expense to the catchers or fisherman.

Various and numerous laws have been enacted to protect the young fish, but the enforcement of these laws is difficult and in many cases, impossible of enforcement. Admitting, then the necessity of the protection of the young fish after having been placed in the waters by the states and the United States, the question that confronts us is how? I believe that if it comes within the constitutional powers of the United States, congress should pass suitable interstate laws for the protection of fish. I have not had time to go into this question, so am not prepared to pass on this. But something has got to be done. In many states the appropriation of money for the propagation of fish is a sheer waste. It seems so strange to me that a legislature which will appropriate money for increasing the fish supply in its waters, still refuses to make an appropriation for their protection. This is so in Maryland at least.

Now as to the remedies:

1st. Laws should be passed in every state placing a size limit on all food fish, prohibiting the catching, having in pos-

session, selling or transporting any fish below a certain size, in other words a cull law should be passed, forcing every catcher of fish to have at the time of taking fish, a culling board, and forcing him to return to the waters immediately all undersize fish.

2nd. Haul seines of every description should be prohibited. In many sections of Maryland, at times, the shores are lined with small fish, ruthlessly and wantonly thrown upon the shore by the seine haulers. I do not believe the stake or floating net does much harm to the small fish.

3rd. Closed season should be regulated by law during the spawning season. The wisdom of this is questioned by many, but I am a firm believer in this method of protection of the parent fish, that it may freely deposit its spawn.

To close, the necessity of protection of the food fish after artificially propagated and placed in the waters is the necessity of proper laws for general fish protection. I believe the states are now awaking, and I hope Maryland will get into the right line at the 1908 session of the Legislature.

DISCUSSION.

Mr. W. E. Meehan: Mr. Chairman, the paper is one of importance. I do not say that I can agree on every point,—the use of the haul seine, for instance, prohibiting such a device. But I do agree that the only solution of the problem is federal control for the enforcement of laws or the creation of laws for the protection of fish. As was stated this morning, when the question of uniform laws on the great lakes was mentioned, it is often difficult to make a uniform closed law, and I question at any rate whether it is advisable to have a closed season, because such laws operate against the artificial propagation of fish. I believe that the solution is in the size of meshes and the size of the fish, and the forbidding of the transportation of undersized fish, either through or out of the state. But, as I said a few moments ago, I believe the real solution is in federal control.

THE SHAD WORK ON THE DELAWARE RIVER IN 1907 AND ITS LESSONS

BY W. E. MEEHAN,

Commissioner of Fisheries of Pennsylvania

There is little that the people living along the line of the Delaware valley are more interested in or guard more jealously than the shad industry in the Delaware River. From the lowermost point of Delaware Bay to the shallows of the river in New York state, the people look forward to and seek with great eagerness the delicious shad as they ascend in the spring to spawn. In comparison with this magnificent food fish any other industry sinks into significance in the minds of the men and women who are within reach of the supply. If any man in his own financial interest talks of constructing a dam, however small, across the river, there is an uproar raised about the matter at once.

If any corporation with plausible declaration that it is chartered for the purpose of benefiting humanity and the convenience of the public, attempts to secure legislation for the purpose of harnessing the river to provide light and power, the newspapers are up in arms at once and the voters along the entire district are out on the warpath among the representatives in the legislature to prevent the passage of any bill which will prevent the free and unobstructed migration of the shad.

The shad industry on the Delaware river has been subject to many interesting and almost wonderful fluctations. It is said that in the early part of the last century the annual catch was worth about $125,000 including the fish which were kept by the farmer fishermen above Trenton for winter use. In those days people came for a distance of fifty or more miles in wagons purchasing or trading goods, especially salt, for shad. About 1860, owing to a rapid growth of population, the drain on the river became very great, especially since all manner of destructive devices were employed for catching of fish. As a consequence before 1880, it is claimed, that the industry had shrunk to a value of only about $80,000 a year.

With the appearance of the United States fish commission and subsequently also by the Pennsylvania fish commission, there was a speedy increase until between 1890 and 1900 there was $200,000 reached. In 1899 and 1900 shad were so abundant in the Delaware river that it was not uncommon during the height of the season for them to be sold in some of the small New Jersey towns as low as $1.50 and $2.00 a hundred. Between 1897 and 1904, Pennsylvania did no shad work on the Delaware river owing to insufficient appropriation. In 1898 the United States fish commission occupied and operated the Pennsylvania fish commission's field station at Bristol for a portion of the season, the Fish Hawk having been taken away for naval purposes by the war department. For two years after the United States government took a very large quantity of eggs from fish in the Delaware river, but immediately after 1900 there was a noticeable decrease and in 1905 when the United States bureau of fisheries operated the state hatchery at Torresdale jointly with Pennsylvania, there were only a little over 3,000,000 eggs taken and most of them from two shore nets, one at Washington Park and one a short distance above Torresdale.

Between 1890 and 1900 the United States could take that many eggs in a single day easily from the Washington Park fishery alone and Pennsylvania could take a like number from four o'clock in the afternoon until nine o'clock from what was known as the Faunce fishery near Riverton. In 1906, last year, the United States bureau of fisheries, if I am correctly informed, took less than 250,000 good eggs from the Washington Park fishery and Pennsylvania only succeeded in getting 3,018,000 good eggs from the shore and gill net fishermen above the Pennsylvania railroad bridge, which crosses the river above Frankford. This year, 1907, the United States bureau of fisheries did not enter the river at all, leaving the entire work in the hands of Pennsylvania.

By hard labor there was taken 5,800,000 good eggs and of this number only 136,000 came from the Washington Park fishery and the bulk were secured from a small shore seine above Torresdale, Philadelphia, known as the Page fishery. The total number was 5,834,000 good eggs. The exact number taken from the Page fishery was 2,065,000. Another fishery owned by a

man named Lovett near Tullytown, yielded 105,000 eggs. The remainder were gathered from gillers, most of whom fertilized the eggs themselves and brought them to the hatchery thus gaining the additional pay per million eggs. The heaviest day's take was 387,000 on June 18, from four nets, one net yielding 154,000, the department of fisheries' own net 100,000, a third net 91,000 and a fourth net 42,000.

There were doubtless a number of eggs lost through the indifference of gillers who operated above Delanco and below Holmesburg. Judging by the take from the gillers between Delanco and Holmesburg about 2,000,000 eggs were thus lost. About 200,000 eggs were sent up from the Bay near Salem, but they were worthless. All the eggs taken were remarkably good until June 19, with few exceptions. In some instances all the eggs were fertilized excepting the ends and the average hatched was a good 90 per cent, with the exception of a few shad that were experimented with by the Department in the hope of augmenting the supply by means described later.

The average period of hatching was seven days throughout the season. In a few instances when the temperature of the water rose rapidly in the hatching house, incubation period was only three days. I should explain at this point that the water used in the hatching house was not taken from the river but from a pond supplied by a small stream which flows through the hatchery grounds. Ordinarily this water had a lower temperature than the river water, but naturally was subject to more rapid rise.

A noticeable feature in the work in 1907 was the great increase in the number of shad which entered the river. Fishermen, as far as I can learn, without exception, declared that more fish had been caught per net than in any single year since 1900. There were, however, less shore nets operated this year than in any previous year since 1900, excepting 1906. Although there were fully as many gill nets in certain parts of the river the fishermen combined and as a consequence notwithstanding the greater catch, prices ruled much higher than in former years even exceeding those of 1906. As a result nearly all the fishermen made money. One small shore fishery cleaned up over

$2,000. Throughout the season the prices ruled $45 for bucks and $80 for roes at the nets.

A catch of over 50 to a drift was not uncommon on the stretch of river between the Pennsylvania railroad bridge and Trenton. On one occasion there was taken from the department's own gill net 28 fish in a drift of less than a quarter of a mile. It was therefore not a lack of fish which caused the department's spawntakers trouble in securing eggs, but a lack of ripe fish. There were only 132 spawners caught. Indeed two of these were not quite ready to yield their eggs when taken from the nests.

The mentioning of these two fish recalls also another very curious fact, namely, the unusual large number of females which were within 24 hours of being ripe. A conservative estimate would be about four or five females in every 25 in this condition. The color would be brilliant about the vent and the vent itself would be protuding and when the fish was handled the eggs would be found to be loosened but could not be expressed. A number of these fish at different times after being caught were placed in a cool spot in the hatching house and allowed to lie there a half hour to an hour and a half and in two instances at the end of the period about two thirds of the eggs could be taken, but the hatch from these eggs was less than 50 per cent.

The first eggs were taken on May 5th from a fish caught by a giller and yielded 28,000 eggs, and this fish was secured after the water temperature of the river had been 60 degrees for nearly a week. The water temperature then fell to 58 degrees at which it remained until May 15th, with scarcely any variation. On May 15 there was a slight rise in the water temperature and on that day one giller took 49,000 eggs and 36,000 were taken from the Washington park fishery, the first taken from any shore net. From this time on until June 1st eggs were taken daily in small quantities and by the last of May there had been taken 2,602,000 good eggs. The highest take was 378,000 on the 17th, the water temperature being 58 degrees. On May 15 only 30,000 was taken with the same temperature. On May 13, 158,000 and on May 20, 283,000 with a 58 degree temperature. On May 31, 202,000 were taken. The weather was very warm; the water temperature a trifle over 58 degrees, but the water was muddy.

All the eggs were taken daily in the evening during May.

With the exception of two or three shad all were taken between four and ten P. M. Apart from the big days there was only an average of one ripe fish per day taken. From June 1st to June 20th inclusive, there were taken only 3,232,000 good eggs. On May 31, a female was caught which yielded 98,000 good eggs, the largest number of eggs ever taken of which the department has a record from a single fish. The fish weighed twelve and a half pounds.

On the same day a fifteen pound shad was caught by one of the gillers. It was a hard female. The owner of the net had intended sending the fish to the hatchery to be mounted, but unfortunately during his temporary absence from the net, his helper sold the fish for $2.00.

A curious feature of the run of shad in 1907 was that quite frequently when a ripe female was secured there was difficulty in finding a suitable male, and twice it became necessary to fertilize eggs with herring milt. Of these eggs only 50 per cent hatched. On one occasion a giller thinking a ripe male was in sight, took the eggs from a female but found the male was not in condition. He thereupon covered the eggs with water, set them in the seat and cast his net out immediately and made another drift although the state of the tide was not favorable, and after a lapse of little over an hour succeeded in getting a male. Notwithstanding this very long delay this lot of eggs were very fine. Over 90 per cent of them hatched.

For several years the laws of Pennsylvania and New Jersey relating to fishing on the Delaware river have not been uniform in accordance with the treaty or agreement between the two states which was entered into in 1794. Under the New Jersey law shad fishing closes on the 15th of June and Pennsylvania on the 20th. As a rule the shore men cut out their nets about the third or fourth of June on both sides and by common consent the gillers stop on the 15th. The Pennsylvania men stop usually because they are afraid if they got their nets beyond the midstream the Jersey wardens will arrest them. This year because of the unusual number of fish and the high price prevailing the owners of the shore nets on the Pennsylvania side wished to operate until the 15th at least, but some of the fishermen had other ideas and they were therefore compelled to cut out

a day or two after the usual period. By an agreement between myself and the New Jersey commissioners, we decided not to be too strict in the operation of the nets of those gillers who had been bringing eggs in regularly and on the 20th with the concurrence of the New Jersey commission, I issued employment papers to three of the best gillers operating on what is known as the Torresdale drift between the filter plant and Torresdale wharf with the intention if the experiment proved successful, to continue the operation of those three nets as long as eggs could be taken, even though it might extend into July. On Thursday night, June 20th, the three gillers took perhaps 400,000 eggs, but they were all bad. On the 21st a like number were taken and the eggs were all bad. The three giller's nets were therefore cut out. We operated our own net after midnight Sunday the 23d and caught two ripe shad and the eggs were worthless. Operations then ceased finally.

Referring again to the paragraph relating to the number of fish which were nearly ripe lacking only 24 hours at the most, this fact determined me to try some experiments, one of which was as I have already related, taking the most nearly ripe and laying them aside with the result already noted. A second experiment was to transfer specimens to one of the ponds in the hope that the fish would ripen. Unfortunately, we had only a gill net fhom which to take fish to try this experiment. The dozen specimens were therefore not in the best condition all being more or less bruised by the twine. Of the 12 fish 11 died within an hour. The 12th fish lived in the pond all night or until about dawn but the eggs could not be taken nor could they be taken from any of the specimens. We then determined to try holding fish in cribs taken from the Page shore fishery, the nearest seine to the hatchery, but unfortunately this determination was arrived at too late for the shore fishery cut out on the day we secured the lumber. This experiment therefore will have to lie over until next year. We had intended making a crib 12 feet long, four feet wide and four feet deep of boards with space of an inch to allow the water to flow through freely. Inside the box we intend to set a form or box of cheese cloth so that when the females were placed therein they could not harm themselves in their frantic rushes up and down the box or crib. As the question of

taking shad eggs has become not only on the Delaware but elsewhere a serious proposition an expression of interest has come from others who have been engaged in shad work as to the character of this proposed crib and whether something better can be devised.

The increased number of shad in 1907 in the Delaware river points in my mind to one inevitable conclusion, namely, that it is water temperature more than anything else which causes a marked increase or decrease in the run of shad rather than nets or pollution. I have no doubt whatever that improper nets and water pollution are factors, and perhaps large factors in this matter and therefore needs to take serious consideration by the states concerned. For example, in the Delaware Bay gill nets are in operation of very great length and in operation for practically 24 hours in a day. These nets are operated by Swedes and Norwegians who work with double sets of nets and double shifts of men. These nets stretch, relatively speaking, nearly across the bay and lap each other. The operation of such nets, of course, must have the result of preventing a full run into the river, but even these nets last year and for the five preceding years scarcely paid.

Small mesh shore nets unquestionably are an evil and catch and destroy thousands of small shad. Contrary to the usual belief we find that yearling shad had come into the river. They are about the size of a herring and I have seen heaps estimated to contain four to five thousand in the markets selling at 50 cents per hundred, or the price of herring. Hence a small mesh net must inevitably be a factor in destroying the fisheries and I feel that no shore net should have a mesh less than four and a half inches even in the pocket or bag. I particularly mention shore nets in this connection for the reason that on the Delaware river, notwithstanding the laws of both New Jersey and Pennsylvania require a minimum mesh of four and a half inches stretched measure, no giller uses less than five inches and the majority use a mesh of five and a quarter to five and a half, while most of the shore men use a net with a mesh in the pocket or bag as small as two and a half, as they claim, not of shad but of herring.

While I believe that improper nets and water pollution are

factors against an increase in the number of shad and perhaps have had something to do with the decrease in the number of fish in the six years preceding 1907, the results in 1907 show to my mind conclusively that there is something else of greater importance, namely, water temperature. It is a well known fact that shad come into the river freely when the water temperature is below 59 or 60 degrees and on examination of the records we will find that since 1900 and until this year the water temperature of the Delaware river during the greater part of the shad season has been below those figures. The source of the Delaware river is supplied by water from the mountain streams of Pennsylvania, New York and northern New Jersey. Beginning with 1900 there have been phenomenally late springs in those sections. There have been heavy snowfalls during the middle and latter part of April and even early in May throwing vast quantities of snow water into the Delaware river and so lowering the temperature. In 1906, for example, the average water temperature in the Delaware river at Torresdale was 57½ degrees during the first half of May and for the whole month of May it was only 59½ degrees. Between the 20th of May and the first of June the water temperature was a trifle over 59 degrees. In Wayne and Pike counties, Pennsylvania, and the adjoining counties of New Jersey and New York there was a nine inch snow fall during the month of May. The lakes and stiller streams of Wayne county and Pike had on several occasions a quarter of an inch of ice. This is from my own knowledge since I was in Wayne county at that time personally directing field work. In April it was less than 45 degrees for the last half. A curious fact in connection with last year was that the latter part of March and the first week in April the weather in the extreme upper Delaware was very warm and the temperature of the water went up, but the freezing and snow weather which I have mentioned began on the 15th of April. Exactly the same conditions prevailed in 1905. On the 16th of April there was 18 inches of snow in Wayne county. This year there was also a very warm spell in March so that the shad began to run very early and then came a very cold spell. During the month of April the lowest water temperature was 43°, the highest 56° at Torresdale with an average for the month of 49°. For the first

half of April the water temperature ranged from 43° to 50°, the second half from 43° to 56°. The average temperature for the month of May was 57.75°. The first week the average temperature was 60°, the second 58°, the third 57°, the fourth 56° and it will be noted that the greater take of eggs was in the second week of May. In June the average temperature was 61.78°. First week 60°, second week 61°, third week 62° and the fourth week 64°.

The greatest number of fish within about 24 hours of being ripe was during the third and fourth weeks in May with the temperature average below 58° and there was also during that period a notable decrease in the number of shad caught. The greatest number of shad caught throughout the season was in the two weeks in June and I have no doubt judging by the number of fish caught by the three gillers in our own net that the catch would have been much larger in the third week for each net that was in operation caught a much larger percentage than before.

If water pollution had been a very heavy factor in determining the run of shad there could not have been any great increase in 1907 over previous years for the reason that the river is just as badly polluted today by the cities of Philadelphia, Camden and Trenton as in former years and if anything the oil nuisance at Point Breeze was worse. The only effect that I could see in regard to the pollution was that after the water temperature became highest in June, the fish caught in the neighborhood of Torresdale tasted strongly of the pollution. The data therefore in the possession of the department leads to the conclusion that nature rather than man is responsible for the marked fluctuation in the run of shad in the Delaware river.

(Applause.)

DISCUSSION.

During the reading of the paper, Mr. Meehan made the following comments:

(1) I might add here that those eggs taken in Bay, were taken late in the season.

(2) Washington Park Fishery is below Philadelphia.

(3) Showing that with the temperature of the water going beyond 64° or 65°, as it did, the eggs were likely to be bad.

(4) Furthermore, the fish did not appear to have ripened any further, in the slightest degree.

President: This very interesting paper is now open for discussion.

Mr. George Mathewson, of Enfield, Connecticut: I was very much interested in Mr. Meehan's paper. Our experience on the Connecticut has been almost identical for this year. What interested me most was that you took the eggs and held them for an hour or more before getting the male to fertilize.

Mr. Meehan: That was one case.

Mr. Mathewson: You have not tried it any further than that?

Mr. Meehan: That was the only time.

Mr. Mathewson: We have been very short of male fish here in Connecticut. Lots of times we could have taken hundreds of thousands of eggs, and could not get the male fish to impregnate them. We never have been successful in holding them. I would like to know if there was a way to do it.

Mr. Meehan: This was done by the giller. We would not try it if we could get out of it. It was too risky.

Mr. Mathewson: We were not in just that position. Where we were, we could not get the females.

President: How many eggs did you get in the Connecticut?

Mr. Mathewson: About a million and a half of good eggs.

President: How was it with the number of fish there?

Mr. Mathewson: We had a very short season. While they were getting fish, the season was short; the temperature was down to about 53° or 54° all the way through there; had hardly any fish before the 7th or 8th of June.

President: I should be glad if you would speak on this subject of the pollution of the water, and fishing, and so on, as affecting the run. I should like to know your experience in

Connecticut. Do you feel the temperature in the river is an important factor in determining the number of shad that run in?

Mr. Mathewson: We have, of course, felt the pollution has been a great factor. We don't know exactly what to lay it to, entirely. We think that the pound nets at the mouth of the river are destroying more of our shad.

It doesn't give them a chance to come up in the river and propagate. We have not been able to get any legislation to get them out of the way. Our river fishing pound men are working seven days a week, and catch everything before they can get into the river to propagate. Then, we think the Enfield river has been a great factor in reducing the number of our shad. We don't get lots of them. The only place we have now, practically, to get shad, is on the Farmington river, in Connecticut. Of course we think pollution is a great factor.

President: You feel that your Delaware shad would get past those pound nets?

Mr. Meehan: We have no pound nets in the Delaware river.

President: I mean, the gill net in the bay.

Mr. Meehan: Some of them get by, because we catch them in large quantities above; but undoubtedly they take a great many fish. How many, we haven't quite the means of knowing, because those men don't make the returns to us, the same as other fishermen are willing to do. They seem to like to conceal it, push them off to this market and that market, and we have no opportunity of finding out how many they do catch. They are of enormous size. The fish get through the pollution. Of course there is no doubt in my mind that it is an enormous factor. My figures here have been borne out by the United States commission. I received a letter from Washington a few weeks ago. They asked me if I would not make a statement as to the character of the work and so on, and they write on the same line, that they have taken an increased number of eggs, and an increased number of fish in the other rivers, Susquehanna and Potomac, and the rivers southward,—an increased number of eggs have been taken, but the increase has not been

proportionately to the increases in former years. Now, whether that is due to the factor of pollution is something, of course, I cannot say. There is no doubt that it is a factor. But the fish do get through that pollution, and the pollution is just as great in the Delaware river as it was ten years ago, and there has been an increased run of shad in the Dealware river, showing that they must get through.

President: I should like to ask whether you think that the getting of say, five million fry, is going to keep up the fishery work in the Delaware river?

Mr. Meehan: No, I do not think five million fry is going to keep up the work in the Delaware river, not by a good deal. I think it will take a great many more than five million fry to keep up the supply in the Delaware river, with the demand that we have for that fish, not only in Philadelphia, but in New York. A large number of our fish go into the New York market, and Trenton, Camden and other points. Fifteen million will not begin to do it. That sort of thing, continued, simply means ruin for the shad fisheries. There is no question about that. We must try to devise some means by which we can get more eggs from the fish that come in the river, by some means, or through artificial means, in order to ripen the fish, somewhat on the lines they do with the whitefish; otherwise the shad fisheries are doomed.

Mr. Seymour Bower, Detroit, Mich.: I would like to ask Mr. Meehan if he has any idea what proportion of the shad which enters the Delaware river and the other rivers that flow into the Delaware are permitted to reach the spawning ground, or a point where they will spawn, if taken. Isn't it a fact that a large percentage are captured before they reach the spawning ground?

Mr. Meehan: Of course that is a fact, a large proportion. Nevertheless, there are a large number of fish that do reach the spawning ground. The natural spawning grounds on the Delaware river are above Trenton, from Trenton clear up to the New York line. Every pool above Trenton is a spawning pool, if of any size, and up to—well, even last year—I saw fish, and fish in

some numbers, spawning up in Monroe county. Quite a number of fish could be seen working back and forward on the surface of the pools, in the act of spawning, and there were quite a large number of young fish that went down the river last fall, and went down remarkably late. They didn't go down until nearly December, and it was the middle of December before the last run of young shad was reported to me. Of course the larger percentage of those fish are destroyed, there is no question about it.

Mr. F. N. Clark: This paper by Mr. Meehan on shad is very interesting. Mr. Meehan, I took shad eggs and hatched them on the Delaware river thirty years ago this summer—I think it is thirty—either thirty or thirty-one years. I think the most interesting thing, and the greatest experiment to be tried and worked out with the shad is penning. In 1883, 1884 or 1885, I can't give the year exactly, the United States Fish commission, with the rivers and harbors committee on appropriation, spent probably fifty or one hundred thousand dollars at Havre de Grace in building pens at the Battery station, for the purpose of penning shad. I was there one or two years. We made many experiments in that line, and we found that it was utterly impossible to pen the female shad and get good matured eggs. There was no trouble with the male. The male would go on developing, and we could use it, but the females would not.

You spoke of some you laid down in twenty-four hours that would not ripen. They were what we call plucked. It was impossible then to find shad that would ripen. If her eggs would not come—if she was not ripe enough so that they would come when she would come out of the net, they never would ripen in that pen. I don't know if any of you have ever been there and seen that pen in its early days, but it was built in as perfect a shape for holding fish as it could be, probably 200 by 300 or 400 feet, just as natural a place as could be for shad, excepting that they were confined in that. They were hauled even from the net—some of the fish hauled up, and not handled; they were hauled up in this apron and looked at; anything that looked as though it was about ready to spawn was taken out, and the balance was put in this pen, without handling them. I want to see the experiment continued to be tried. In my own opinion, I do

not think that you can ever hold a female shad until she ripens, on account of the kind of fish being caught. Now, if shad will spawn at a temperature down to 50° or 55° it might be possible for you to do it. To my mind that is the salvation of your shad work on the eastern rivers, if you can ever get them so that you can hold the female shad until they ripen, as you do the whitefish. Of course at an early day we did not think we could hold the whitefish. Now it is a matter of so many fish, so many eggs.

Mr. Meehan: It seems to me this is a matter which calls for the best skill of all the fish culturists who have anything to do with rearing shad, because we have no more serious proposition before us to-day than the shad. There is apparent danger of its becoming extinct. And unless something is done, or some means is found, as Mr. Clark has stated, of penning those fish, I see nothing before us but the loss of the shad in time.

President: Can't you rear those fishes at the mouth of the rivers? Isn't that possible?

Mr. Meehan: If we could secure uniform legislation between the states we might. New Jersey and Delaware have passed what they call a uniform law. It is uniform as far as it goes, but it did not have a thing to say about those long Swede nets, in the lower part of the Bay.

OBSERVATIONS REGARDING THE VARIETIES OF RAINBOW TROUT AND THE TIME OF THE SPAWNING OF THIS SPECIES

BY E. RAVERET-WATTEL

Director of the Fisheries Station of the Nid de Verdier, Fecamp, France.

The piscicultural Station of the Nid de Verdier has occupied itself for about 15 years in raising of the rainbow trout. *(Salmoiredeus)*. The fishes of this species which the establishment possesses in its ponds, come from two lots of eggs, which were kindly sent by the station at Wytheville, according to the instructions of the United States commissioner of fisheries.

The trout obtained from these eggs were at first nearly alike and belonged, we think, to the variety, which Prof. Jordan designated as the "McCloud River Trout," *(Salmo irideus Shasta)*. There were slight differences in color in a few of these fishes but scarcely noticeable. But, little by little, these differences became more accentuated. Although the fish were all placed in conditions absolutely identical, as to nature of water and kind of food, at each generation the differences in color became more and more noticeable and in fact there are now in the ponds of our station, specimens presenting the most diverse appearance. Some have a reddish tint, sometimes a little violet, spread over the entire body, and in these fish, the red band of the side is almost always very wide and of very dark shade; in others this band is of a very light color. Others are of a rather golden yellow, (jaune doré) sometimes light greenish, with the red band on the sides narrow and reduced, so to say, to a simple thread more or less dark. Finally, others, and they are today the most numerous, have an aspect generally very light, almost silvery, which immediately strikes the eye, even of people not interested in pisciculture. Thus the fisherman and the consumer of this region designate these light colored trout as "white trout" in opposition to the name of "red trout" of the Nid de Verdier which they give to the rainbow trout, whose general color is a little reddish, and which the station has planted in the rivers of

the Department of the Inferior Seine. In these streams is also caught the common trout.

The red band on the side of the white trout is usually quite narrow and lightly marked. At the same time that these changes of color appeared, more remarkable modifications were produced in these fish, by creating among the several permanent varieties perpetuating themselves by selection. Two of these varieties deserve special mention:

1st. In the trout which has a general reddish color and the lateral band wide and strongly marked, the abdomen is very large on account of the considerable size of the digestive tract. This is correlated with the voracity of the fish, which has an insatiable appetite. In both sexes the organs of reproduction occupy much space in the abdominal cavity, as spawning time approaches. The very voluminous testicles of the males produce an extraordinary quantity of milt; in the females the ovaries yield a great number of eggs, which are quite large and generally red.

This variety of the trout is extremely robust and easy to raise. The fry which are very vigorous, take artificial food readily, eat much, grow rapidly and are little troubled with sickness. In a word, the fish presents in the highest degree, qualities which determine the value of the rainbow trout, and which give it, so far as ease of raising goes, a very great superiority over the common trout of Europe. *(Salmo fario)*. This variety is further distinguished by an interesting particularity: the early date of spawning. When we began to raise the rainbow trout, the laying of eggs of these fishes generally took place in February and March, with very slight variations each year, according to the temperature of the atmosphere and that of the water. But as little by little there was formed under our eyes the variety of "red trout" we saw that the date of the spawning of these highly colored fishes advanced in a remarkable manner, that is to say, that the laying of the eggs took place more and more early, first in January, then at the end of December, then at the beginning of December, and finally at the end of November. For the last five or six years, certain fishes, particularly early, permit us to practice artificial spawning from the 28th of November and even from the 26th. This is, of course, an advan-

tage, since we thus obtain fry, which, born very early, get, in their development a perceptible advance over the others.

2d. Our variety of light colored Rainbow trout, commonly called "white trout" is noteworthy for the small size of its digestive organs, which occupy only little space in the abdomen. The genital glands are small. The testicles furnish only a little sperm which obliges us to maintain a large proportion of males, lest we should sometimes lack milt at the moment when artificial fecundation is practiced. The ovaries are also very short, and give only a limited quantity of eggs, which are quite small, generally white or yellowish, rarely pink. The fry obtained from these eggs is more delicate, less easy to raise than that of the "red trout;" they require more careful attention, accustom themselves less easily to artificial food, eat less and very frequently die, at least during the early part of raising. They are wilder, more timid and in this regard resemble much the young European trout.

But if the "white trout" is not very satisfactory in this regard, it possesses the advantage of having a more delicate flesh than its congener. Although all our fish are, I repeat, raised in identical conditions, receive the same food and live together in the same ponds, the "red trout" is less palatable than the "white trout." Their flesh is a little soft and keeps less well. In consequence of the large size of the intestine always full of food recently eaten, which decomposes rapidly, the dead fish keeps fresh only a short time. This depreciates it a little with the lovers of fine dishes and affects its commercial value. The "white trout" is much desired because of the delicacy of its flesh, which has an excellent taste, is delicate but not soft and is easy to keep. Consumers who have had the opportunity to eat both forms (red and white trout) recognize the difference very easily. The merchants, also the restaurant keepers, etc. of our neighborhood, to whom the station is authorized to furnish the fish exceeding the need of the station, always ask for this "white trout," which are so much preferred by the connoisseurs.

In contrast to the change of date of spawning of the "red trout," that of the "white trout" has remained late and even very late. It hardly spawns before the end of February or the

beginning of March, at a time where all our other rainbow trout, even those which do not present a particular intensity of the red color, have already completely finished spawning.

I thought it would be of interest to bring these facts to the knowledge of the American Fisheries Society. I should be much pleased if these facts should be deemed worthy of attention by my honorable colleagues of the Society and I should be very thankful to them if they would kindly give their opinion regarding the causes which could bring about the production of such notable differences in fishes, having all, as it seems, the same origin, living in common, in the same ponds and receiving absolutely the same food. (Applause.)

DISCUSSION.

President: This paper is open for discussion. I should be glad to hear from some members who have had experience, if there is any story to tell in this country. Are there none of our trout men here?

Mr. Clark: I think Wisconsin has had experience.

President: We have had a lot of experience, but so far as I am aware we have had nothing at all that has been parallel to this. This seems to be a case of substantially the formation of a new variety, a very decided change in the habits, under new conditions. Of course our conditions in Wisconsin are not essentially different from those of the normal rainbow trout.

Mr. Clark: This is their native element.

President: We therefore, have very little that we can say, so far as I am aware nothing that parallels this. The paper does not go into discussion of the point, that we should all of us, at least those interested from a biological point of view, like to know, and that is, how this new variety was formed, whether it came as the result of somewhat rapid evolution on the part of a few fish or whether it was something concerning a considerable number of fish. He speaks of having two lots of eggs, and does not say whether this white variety has come from one lot of eggs, or from individuals belonging to both lots. Of course, if they came from one lot of eggs, something in the history of

those eggs on this side of the water might be responsible. But if that is not the case, and if has come about in a gradual way by individual fry here and there taking on this light coloration, I fear it is a problem that they will have to work out, because, so far as I am aware, nothing has been found in the hatcheries of this country. I shall be glad when I go back to make inquiry of the men in charge of our hatchery, and to put into the minutes of the society anything they may know and which I do not, which bears on this subject.

Mr. Clark: I would say, Mr. President, at Northville we are not doing anything with the rainbow trout now, except that what eggs are forwarded for us from some of the stations, we hatch, and grow fingerlings. We have rainbow trout in our ponds, but no eggs are taken from them. Nothing at all is done in that direction, and we know nothing about them except that we receive the eggs, hatch them out, and plant them. The principal work of Mr. Segall of Wytheville, of Mr. Dean of Neosha, and of Superintendent Johnson of Manchester is in connection with rainbow trout.

President: I think it would be well to send this paper to some of the gentlemen.

Mr. E. N. Carter, St. Johnsbury, Vt.,: There are some rainbow trout at St. Johnsbury station, but they are not handled there any longer, and they simply died out; water did not seem suitable for them. Every spring the trout would come out with sores on their bodies, and many of them finally went blind, and eventually they were all turned into a stream near the station.

Mr. Bower: I would like to inquire whether these white trout and red trout all changed their spawning season, so that all practically spawned in November.

President: No, the red trout changed their spawning season, not all of them, so that the spawning season lasts from November into March, but the white trout have not changed their spawning season.

Mr. Bower: We have handled rainbow trout, but never noticed any such differentiation, nothing comparative. Of course,

we have steelheads and rainbows, and there is a slight difference between those two, but even those two species are more nearly alike than the white and red that he mentions, both in their appearance and spawning habits.

Secretary Peabody: What is your judgment regarding their edible qualities, as mentioned by him, the difference between the rainbow trout and others—is there any difference?

Mr. Bower: We find our rainbows are all alike, not good fish for the table.

Secretary Peabody: That is what he says.

President: His white trout?

Secretary Peabody: His white trout—he has got something else mixed up there.

Mr. Bower: I was just talking about trout with a gentleman, and I would like to have him state his experience.

President: We shall be very glad to hear it.

Mr. B. O. Webster, of Bellefonte, Pennsylvania: We have, at Bellefonte, Pennsylvania, a pond of rainbow trout, and our attention was called to the fact of their being ready to spawn in the later part of November, and the pond was drawn and at least one quarter of the fish were found ripe and ready to spawn. The males were especially ready with milt, and about one quarter of the females at that time, and within one month after that time, we finished spawning our fish. The natural spawning season of the rainbow trout varies, I know, in different parts of the United States, but Mr. Bower was saying it seems very queer to him that some trout spoken of in that paper should spawn at that time of the year, while in the northern part of the state at Corry, they find that their fish spawn in the spring, as they do in some other parts of the United States, where they are in their natural habitation.

President: How long ago was this, Mr. Webster, that these trout spawned in November?

Mr. Webster: Spawned last year and the year before. That was the first.

President: Their young have not yet come up to the point of spawning?

Mr. Webster: Their young have not. One year from next fall, their young will spawn.

Mr. Meehan: I can relate another rather curious circumstance about this. Many years ago, we received a quantity of rainbow trout from the United States government and hatched them in the hatchery at Marietta. The stock was divided in two parts. One was sent to Corry hatchery and one was transferred with the other stock at the Marietta hatchery to Allenton, the distance between the two stations being about 400 miles east and west. Now these were all from one stock. The fish at Corry hatched at the usual time, early in the spring. Those at Allenton spawned, and spawned regularly for years, about the same time as the brook trout, from the middle of October to the middle of November.

President: Your experience has been entirely parallel to that of the French hatchery.

Mr. Meehan: I missed the paper. These fish that we had at Bellefonte are not progeny of the fish there, because finding that the fish did not propagate naturally in the stream, the propagation of rainbow trout was for several years abandoned. And recently we took it up again on the idea that we could have our fish spawn in the spring, when our troughs would be empty; and the fish we are now having were from eggs received from the United States government. I think the fish over at Bellefonte came from Wytheville, but I am not sure. We now have some fish that will come into spawning at Corry this coming fall.

President: You expect them to spawn in the fall?

Mr. Meehan: I say this fall, I mean with this natural period they will come in spawn there this year.

Mr. Buller: I have a pond of these fish which came from Wytheville, Va., and some of them spawned in February, that

is, in a pond at a temperature of 46 degrees F. The water is very soft in the natural stream. I noticed in the month of March, California trout spawning in the stream.

President: The paper has two points, 1st, that the rainbow trout were beginning to spawn in the fall in France, and the other, that they were having a variety of white trout. Have you had any such experience of the formation of varieties?

Mr. Carter: Isn't it true that the rainbow trout of Wytheville spawn in the fall.

Mr. Clark: December.

Mr. Root: December and January.

Mr. Clark: They commence in December.

Mr. Carter: Naturally they spawn on the Pacific coast in the spring.

Mr. Fullerton: Mr. President, we in Minnesota raise rainbow trout. We have never found that they varied in their spawning at all. We tried an experiment four years ago; it was very funny to me; I never thought very much about it. Every fish culturist knows he will find very dark and very light fish in the same lot of fish. The superintendent at the St. Paul hatchery conceived the idea that he would take the male and female light and keep them separately, and the dark and keep them separately, and he has produced trout of very dark and very light color, and it occurred to me that if he would keep on with the experiment, separating the light and dark, he would get all light and all dark specimens. We have them at St. Paul swimming in the pond, through this experiment, taking the male and female of very light colors and mating them.

President: That is what one would expect.

Mr. Fullerton: We have a lot of those trout, and we raised them and sent a lot down to the Jamestown exposition this year. The funny thing about that is, taking a black female and black male, we have never been able to secure a single white one.

Mr. Carter: Wouldn't it be interesting to know what depth of water these fish are carried in that are so light in color.

President: Evidently they are living there under the same conditions. He speaks of conditions being exactly the same.

Secretary: Are the fish living on natural food or artificial food?

President: The writer of this paper does not state what he feeds his fish on, except that they are all fed on the same kind of food.

N. R. Buller, Pleasant Mount, Penn.: I have had a similar experience with California trout, and I attribute the variation in color to the feeding in ponds. The river-fed fish will vary very much in color. We have green, black and light variation of half a dozen colors, but has anybody ever noticed this among the trout where they receive their natural food.

THE CULTIVATION OF FISHES IN SMALL PONDS

BY CHARLES H. TOWNSEND

Aquarium Battery Park, New York City.

In presenting this paper to the Fisheries Society, I do so less in the hope of affording instruction to professional fish culturists like yourselves, than of creating some discussion of the subject and profiting thereby myself. For several years I have been experimenting with small natural and artificial ponds on private estates in the vicinity of New York, with a view to ascertaining their possibilities for producing the commoner fishes. Requests for information on the subject of home fish ponds are being made constantly by the public. I have arranged the matter under the general headings of "Natural Ponds" and "Artificial Ponds" and have attempted to present brief and general instructions for their management. The raising of trout is not considered in this connection. Trout require special conditions of water supply and temperature, seldom found on the farm. For the ordinary run of ponds, it is necessary to restrict the list of available fishes to the perches, basses and sunfishes to which they are adapted.

Natural Ponds or Lakes.—It is assumed that the position of the natural pond is such that no arrangement can be made for drawing off the water. Its possibilities will therefore have to be considered separately. Its fish life moreover can never be brought under complete control. If the character and abundance of the fish life in the pond are not known it is desirable that it be ascertained as far as possible by fishing or netting. If the pond is without any fishes it should of course, be stocked at once, and the selection of fishes made with due regard to its natural conditions. The extreme depth, mid-summer temperature, plant life and character of the bottom of the pond should all be ascertained. The summer bottom temperature of deep ponds should be known. It can be taken by lowering the thermometer in a pail and allowing it to remain some time. If pulled up rapidly the temperature will not have time to rise materially.

A series of bottom temperatures will serve to indicate the presence of bottom springs.

A wide area of shallow water in a pond not well supplied by springs or rivulets usually means great warmth in summer. If such a pond can be temporarily lowered and deepened in places, its conditions for fish life would be greatly improved as there is a decided difference in temperature between surface and bottom waters. Below six or eight feet the temperature decreases at the rate of about two degrees for each foot of depth. Increased depth would also give fishes an additional chance for life in winter when heavy ice diminishes their supply of air. A small pond, supplied chiefly by rainfall, may be increased somewhat in water supply by leading to it ditches from adjacent fields; while its depth may admit of some increase by embankments. If water can be had by boring, an artesian well may make just the difference between a poor pond and a good one. Fish ponds should have water plants to afford shelter for young fishes and harbor the various forms of aquatic life on which they feed. Several kinds of common pond weeds will serve for this purpose. The broad leaves of water-lilies afford shelter in summer for the large fishes and should be introduced. If the pond be very small and unshaded, some floating boards will afford shelter. Too many large fishes in the pond are detrimental since they are consuming the food supply and are themselves going to waste. When such fishes can not be taken with the hook as sometimes happens, they should be removed with a seine if it is possible to do so, and marketed. It is important that the mature fish crop of a pond be utilized and the young of the year be given a chance to develop. The accumulation of large fishes serves no useful purpose, but results in overstocking, exhaustion of the food supply, cannibalism and stunted growth.

If a natural lake or pond is already stocked with carp, which are not desired and can not be entirely removed, their further increase may be checked by the introduction of black bass which feed freely on young carp. Black bass will also keep other species in check by devouring their young, and thrive amazingly in the process. If the waters contain black bass, or other fishes, which have become stunted from overcrowding and the exhaustion of the natural food supply, it is important to reduce their

number by any methods of fish catching that will prove effective and to restore the food supply by introducing other species.

If numerous adult yellow perch are added their young will contribute to the food of the bass, and other large species. Experiments have shown that fishes stunted from overcrowding are not necessarily permanent dwarfs, but will attain a larger size if well fed or removed to more favorable waters. No fishes could be more stunted and worthless than those now swarming in the lakes of Central Park, yet we have succeeded in doubling the size of such fishes in two years. Stunted European rudd, transferred from Central Park to Prospect Park, began developing, and later, when we seined them out for exhibition at the Aquarium, it was found that their size compared favorably with that which they attain in Europe.

All ponds, whether natural or artificial, containing food-fishes should be stocked with brook-minnows, shiners, chubs, freshwater killifish or other small species to constitute a food supply. The killifish and other small species, it may be noticed in passing are useful in small ornamental ponds in destroying the larvae of mosquitoes.

The full use of the fish crop of a large natural pond or lake can seldom be secured by ordinary fishing. It is necessary that seines and trap-nets be used. Experience has proved that such ponds usually contain many large fishes which will not take the hook. The introduction of new adult stock may be desirable in an old pond where there has been in-breeding, but overstocking is the main trouble, the remedies for which are thinning out and re-establishing the food supply.

Owing to the customary preference for "game fishes," many excellent pond species, such as rock bass, calico bass, yellow perch, white perch, long-eared and blue-gilled sunfish and catfish, have been overlooked. Other kinds such as the warmouth or the white bass, inhabiting waters of the south or middle west, are equally desirable. All of these fishes increase rapidly, take the hook readily and are good fishes. They will multiply in favorable waters with less care than probably any other native fishes. With the exception of the catfish, they will take the artificial fly and afford good sport. They are of considerable commercial importance since according to government statistics, the

quantity annually sent to market exceeds twenty-eight million pounds. Nearly all of them are known to attain weights exceeding two pounds.

Ponds Made by Damming Streams.—Ponds created in this way should on no account be completed without the placing of drain pipes and penstocks, so that the water can be lowered and the fish life controlled. There are marketable fishes going to waste in ponds everywhere for lack of simple facilities for getting at them. The deepest portion of the pond should be at the lower end, where the fish will gather when the water is drained down. Ditches dug in the bottom of the pond, leading to the deep hole, or "kettle," will greatly facilitate the concentration of the fishes at that time.

Two or three ponds will be found to be much more satisfactory than one, since they will permit of the sorting of fishes according to size. Angling or other fish catching would then naturally be confined to the pond containing the large fishes. If properly managed, a series of fish-ponds will naturally yield a surplus for the market. It is dangerous to construct a fish-pond in a narrow ravine as the dam is liable to be broken during spring freshets or exceptionally heavy rains, and the pond will gradually fill up with silt. Even if the embankment is not broken during high water it is difficult to screen it so that the fishes will not escape. A safe plan is to make the pond at one side of the stream, by excavation and embankments, leading the water to it through a ditch, and damming the stream sufficiently at the ditch-head to divert a portion of its flow. In case of freshets, the deep pool formed in the stream by the dam at the ditch-head, naturally receives the silt brought down stream; thus guarding against the filling up of the fish-pond. The ditch itself should be screened at both ends to prevent the ascent of fishes to the stream, and keep floating drift out of the ditch.

If the pond can be excavated in marshy ground, so much the better. A layer of clay on the bottom will render it more watertight than it would be otherwise. The embankment should be broad, and before it is thrown up, all sod should be removed so that there will be no subsequent seepage caused by the decay of vegetable matter. The earth used for the embankment should also be free from sods or other matter liable to decay. The

ground cleared for the embankment should have a ditch extending its full length into which the new earth will settle, thus increasing the stability of the dam.

The embankment of the dam if it is to be six feet high should be ten or twelve feet wide at the base and four feet broad on top. The earth used in its construction will naturally be derived from the bottom of the proposed pond, which will, of course, serve to increase its depth. The overflow should be large enough to carry off the surplus, when the water is high, without danger to the dam and the outlets in general should be screened with wire netting to prevent the escape of fishes. The drain for drawing off the water should, of course, be put in place before the dam is thrown up. Earthen drain-pipes are risky, as no matter how closely the joints may be set and cemented, plant roots will eventually find their way inside and clog them up. Iron pipe of not less than four inches diameter, with the joints well soldered, is more reliable. A hollow log will serve the purpose of a drain-pipe, and wear well. If the drain, or bottom outlet, is built of concrete and large enough to be conveniently cleared, it would be more effective in lowering a large area of water. The upper end of the drain should fit tightly into the foot of the upright penstock in the pond. The penstock itself is merely an upright drain or sluice of planks or concrete, having about the same capacity as the drainpipe itself. It is fitted on one side with short "water boards" sliding in grooves which can be removed one after another, to permit the escape of the water. A heavy plank should connect the head of the penstock with the top of the dam.

Before the new pond is filled, all roots, stumps, rocks and everything else that would prevent the free sweep of a net along the bottom should be removed. All ponds, whether natural or artificial, accumulate debris of which they can not be cleared, expect when empty. A muddy pond will give the fish a muddy flavor. When a pond is being cleaned, it is necessary to remove the fishes from the deep hole or kettle. Any attempt to remove decayed matter and sediment, while fishes still occupy the deeper portions of a pond, may be fatal to them, as dangerous gases are then liberated among the crowded fishes. If the pond is very foul, it should be only partially lowered at first and the fishes re-

moved with a seine. With a reserve pond or two, it is possible, not only to thoroughly clean a pond, but to "winter" it: that is, leave the bottom exposed for a time to the action of the sun and frost. This destroys excessive plant growth and kills out destructive water beetles and other enemies of young fishes and is approved by most professional fish culturists. With a series of ponds constructed at different levels, the overflow of the upper ponds will serve to feed those below. The more fall there is to the water the better will be its aeration—a matter of great importance to small ponds. It is desirable that surface water caused by rainstorms be kept out of small ponds by banking up or ditching.

The following instances, among many which came under the writer's personal observation, will serve to show some of the difficulties in the way of successful management, where ponds are constructed without provision having been made for drawing down or seining:

A certain deep lake of about two acres in Connecticut, formed at great expense by damming a brook, is without any provision for drawing down. The conditions prevailing in it are unknown, and nothing but hook and line or some form of trap-net are available for ascertaining its contents, since its borders will not permit the use of a drag net. In the meantime, snapping turtles kill the young ducks on it each summer, and there is no way of getting rid of them.

Another pond, which could not be lowered, was believed to be without fishes, until the use of a seine in one corner showed that the yellow perch fry introduced two years before had already attained good size. The presence of snags elsewhere in this lake prevented the use of the net. The management of this pond will always be difficult and unsatisfactory.

A lake in the Zoological Park, stocked with yellow perch fry in 1903, was represented to be without fishes, until the use of a seine, sent from the Aquarium a year later, showed it to be well supplied. The full utilization of this lake is however impossible, since its bottom has many scattered rocks which prevent effective seining. If the rocks had been removed originally, a good sized seine would sweep it from end to end.

Water Supply.—The water supply of the fish-pond is the most important thing to be considered. It must in fact be taken into consideration before the artificial pond is made. The flow of water should be abundant. About twice as much will usually be required as the beginner thinks is necessary. Ponds fed by strong springs are excellent and are not subject to the dangers to which stream-fed ponds are exposed. Their temperature is naturally more equable throughout the year and they are less liable to heavy freezing in winter. In warm weather and in the winter time, pond-fishes avoid extreme temperature by frequenting the vicinity of bottom springs. Spring-water, however, contains less life available as fish food, and less air than that from brooks. Its value for pond supply will be improved, if it can be led some distance as a rivulet. Fish-life in small ponds with limited water supply will suffer from heavy ice in winter. The ice should be broken daily, and masses of brush and branches placed partly in the water will aid in keeping air holes open, especially if they are moved by the wind.

Extent and Depth of Ponds.—The extent and depth of ponds made by damming streams, will be governed somewhat by the nature of the situation available. A pond of an acre or more in extent, and with eight or ten feet of water in the deepest part, will, if properly managed, give excellent results. It may be necessary to make it less than one quarter of an acre in extent, but a small pond should have an extreme depth of not less than six feet, although it is quite possible with a strong water supply to raise fishes in very small and shallow ponds. This, however, means active cultivation, with daily feeding of the fishes, numerous ponds to permit of sorting, and all the details of a fish-cultural establishment. As a matter of fact, nearly all of the extensive fish-breeding carried on by the national and state fish commissions has been done in ponds of rectangular shape, averaging perhaps less than 100 feet in length and 25 feet in width, having depths of only three or four feet. Such ponds are worked in series, as nursery and rearing ponds, and there are generally two or more ponds of large size in which fishes of different growths can be held. Ponds to be used for black bass and in fact most other fishes, ought to be several acres in extent and quite deep. In general, fishes kept in small ponds do not

attain the size of those in large ponds since their range and food supply are restricted.

Feeding.—If large numbers of young black bass, rock bass or calico bass are removed for safety to smaller ponds where they may exhaust the natural food supply, it will be necessary to feed them. If they are put in small "nursery ponds" where they are crowded, feeding is imperative. The principal natural food of fishes is fish, which should be perfectly fresh. For young fishes it must be cut and boned, then rubbed through a fine wire screen. Adult fishes kept in restricted quarters will also require feeding. They may be fed largely on live minnows. Among the fish-foods used at the New York aquarium, are live minnows, live shrimps, chopped fish, beef, liver and clams. It is a mistake to suppose that fishes do not require an abundance of food. They may live without it but cannot grow.

Water Plants.—About one quarter of the ordinary pond should be as shallow as 10 or 12 inches and planted with pondweeds, such as potamogeton, parrots-feather (myriophyllum), water-celery (vallisneria), hornwort (ceratophyllum) and cabomba. Suitable plants for the purpose may be found in most streams and ponds, and there are many others than those mentioned. Water plants that are satisfactory in some regions may, however, not be so in others farther north or south. Waterplants are necessary as shelter for young fishes, and greatly increase the various forms of small aquatic life necessary for their food. They also serve to aerate the water, which is most important in small and sluggish ponds. They may be planted by tying to stones and dropping them from a boat, or set in the ground after the water has been partially lowered. The slightly greater depths, from one to three feet, may be planted with water-lilies, while the more extensive and deeper portions should be kept clear of vegetation. If the vegetation becomes too thick it can usually be pulled out with a rake, but it is sometimes necessary to cut it with the scythe. Willow and other trees should be planted at some points to furnish shade. Aquatic insects, crustaceans and mollusks, bred among pond weeds, constitute no small feature of the ponds food supply. It is recorded in the "American Fish Culturist," that an electric light over a

certain pond was found to attract insects which fell in the water in such numbers as to supply an important quantity of fish food. If the pond weeds, together with the brook-minnows, frogs, crustaceans and other small fry which are to establish the natural supply of food, can be introduced a year before the stock fish are put in, the conditions for success will be greatly improved.

Spawning Places. Fish-ponds should be supplied with spawning conditions suitable to the fishes occupying them. Small-mouthed black bass, which make their nests in gravel, will require gravelly bottom. Large-mouthed black bass, which nest among the roots of plants, will find the conditions they require among the weeds of the pond. Yellow perch, which spawn among twigs under water, are easily accommodated—pieces of brush may be set firmly in the bottom where the water is shallow, in the branches of which they will deposit large whitish masses of spawn. If the brush tops extend several inches above the surface of the water, so that they will be swayed by the wind, and kept free of sediment, the hatching of masses of spawn will be greatly facilitated. Rock bass and the various species of sunfish which, like the small-mouthed black bass, make their nests in gravelly places, will absolutely require places of that character if they are expected to increase and a few cartloads of gravel dumped around the lake in water about two feet in depth will furnish the necessary conditions.

Since ponds, to be successful, must have proper spawning conditions, some study of the habits of pond fishes is important and there are numerous helpful books available. It is now the custom with professional fish-culturists to supply artificial spawning nests in ponds containing small-mouthed black bass. These are small shallow boxes about two feet square filled with mixed gravel and sand, which early in the spring are placed everywhere in shallow water around the pond. They are at once appropriated by pairs of basses seeking spawning places. The boxes have boards nailed on two sides at adjoining corners, which extend about a foot higher, affording shelter for the basses similar to that which they naturally seek under the shelter of submerged logs. Basses guard their nets for several days after the spawn has been deposited, and it is the custom at fish cul-

tural establishments to place over the nest before the young fishes leave it, a light circular frame of iron covered with cheese cloth, one end of which protrudes above the water. This prevents the young fishes from wandering away from the nest, and makes it possible for them to be removed with the dip net to nursery ponds, where they are safe from their enemies and the cannibalistic tendencies of their parents.

One of the numerous private ponds visited by the writer, a pond half a mile in length, was examined with great care and found to be totally lacking in gravel areas. Although it had been stocked several times with small-mouthed black bass, there had been apparently no natural increase. With a mud bottom it afforded no spawning surface whatever for this species. The writer recommended the introduction of numerous artificial spawning nests, or the introduction of the large-mouthed bass which would not require gravel beds but could spawn among the abundant water plants. It is probably unnecessary to add that there should be no fishing allowed during the spawning season, which with most of the fishes mentioned is in the spring months.

Number of Fishes Required. In stocking waters it is not necessary to have a large number of adult fishes. For a pond of about an acre in extent, twenty pairs of black bass will be sufficient, and perhaps fifty pairs of any of the other kinds of fishes mentioned. These numbers will in fact suffice for still larger ponds and should be reduced for smaller ponds. When the conditions are right the progeny of the first year will usually stock the pond to the limit of its natural food supply. It should be borne in mind that heavy stocking serves no useful purpose, unless it is the intention to catch some of the adults the first year. It is just as well to stock with two or three kinds of fishes and time will show which species are the best adapted to that particular body of water. With black bass the yellow perch may be placed with safety, not only on account of the food it supplies to the former, but also on account of its own value as a food fish. It is remarkably prolific, and with a good start can usually take care of itself. The same may be said of the catfish. It is harmless since the basses and sunfishes are active in guarding their own nests. The yellow perch and the catfish may also be introduced into ponds containing rock

bass or calico bass. There is no reason why black bass, rock bass, and calico bass should not be kept together if the pond is of considerable size. (Applause.)

DISCUSSION.

During the reading of his paper, Mr. Townsend made the following comments:

1. We cleaned out some ponds, and found the lakes swarming with stunted fish, and by cleaning out some of the ponds, we actually succeeded in getting a good growth from stunted specimens.

2. That is the general run of pond fishes.

3. I may state now that the small ponds of the Zoological Park are now yielding almost enough fishes to supply the park, and that the food bill of this great Zoological Park has been very largely reduced, and we expect to learn enough about the ponds to make them produce very much more than they are producing now.

4. In referring to the size of the ponds, Mr. Townsend said: I think they are 100 x 25. I don't know for sure about that.

At the close of his paper, Mr. Townsend said:

I have presented this paper, Mr. President, in the hope of having it criticised by the members, as I am engaged in writing a more extensive paper on the subject of small ponds for private fish culture.

President: Mr. Townsend's paper is now before us for discussion.

Mr. Clark: In reference to Mr. Townsend's paper, I followed it very closely, and it is a very excellent paper. But, for the individual fish culturist, breeding certain kinds of pond fishes, I really do not see any chance for discussion. It is more on the line of fish culture or rearing fish on the farm. I do not think Mr. Townsend would advise having in our small black bass ponds, perch and sunfish and things of that kind, all in the same pond; and there are some other things that of course the fish culturist would not endorse in that line. I think his paper

is intended more for the general pond of fishes, and therefore I do not see any chance for discussion.

President: There is one small matter to which I would draw attention, for Mr. Townsend has written a general paper. The statement is made that after the depth of six or eight feet, the temperature will fall at the rate of about two degrees for each foot of depth. That is going to depend on the depth of the pond, and on the area, and while that may be true in ponds of very limited size and depth, yet if ponds are to be taken which will range from half an acre up to twenty acres, with considerable difference in depth, there will be found a good deal of difference in regard to this matter of temperature. There will be found a point in any pond of considerable depth where the temperature falls rapidly, but the depth and the rapidity will depend on quite a complex factor.

Is there further discussion of the paper?

Mr. Lydell: One feature of the paper was the large mouth black bass. My large mouth bass have all spawned on gravel this year, with the exception of two or three pairs. There were no beds placed for them, the old gravel beds were left in, and the large mouth bass sought the gravel, and all spawned there with the exception of three or four pairs, and I think I had the best success with the large mouth bass this year of any in my experience.

PLANTING FISH vs. FRY

BY JOHN L. LEARY

U. S. Bureau of Fisheries, San Marcos, Texas

There comes a report from all over this broad country of the growing scarcity of marketable fish, especially is this true of our Atlantic coastal fishes, and such varieties as visit fresh waters to spawn, along with the whitefish of the lakes, and I might say with all the varieties that are handled in the work of propagation. Much of this may be the chronic cry of the disappointed fisherman, yet I do not think we get the results, or that the catch of adult fish is what it should be, when compared with the immense plants of fry made, not only by the bureau of fisheries, but the state industries engaged in the work of fish culture. And while I have no specific remedy to increase the catch of our economic fishes I do believe that by building large retaining ponds in connection with our hatcheries, we could rear many millions of fish to the size of fingerlings, that would escape the many enemies that the poor little fry fall a prey to. Many fry are often made doubly weak by distant tranportation in close quarters, when planted are so weak and inactive that they are readily destroyed by minnows, small fish etc., that are abundant in most waters. Now with large retaining ponds, built at some convenient point to the hatchery, if possible near some stream or lake, where a certain number of fry could be reared to fingerlings, and the surplus fry could be planted as we are now doing, I think we could largely increase the catch of marketable fish. We will take the shad, one of the most delicate fish we handle, yet many of their fry were reared to fingerlings in the ponds at Washington, D. C., and liberated in the early fall. Many years ago when I was a fisherman, I observed often in the shallow waters along the shores of the Albemarle sound, schools of young shad making their way out to salt water, also many young striped bass, 3 to 4 inches long. This migration occurred during August and September. This proves to my satisfaction, that they could be ponded in fresh or brackish water for several months, a period that would change the little weak fry to a strong finger-

ling, fairly able to take care of themselves; and we know that all the fresh water fishes can be ponded with success.

San Marcos station has always planted fish and the results from our plants are most satisfactory, and some of them most wonderful. In the 50 acre lake at Jacksonville, that is now teeming with fish, this year they are catching bass weighing 5 and 6 pounds and one a few days ago weighed over 8 pounds. This lake we stocked 6 years ago. Roony and Butts, we supplied with fish 8 years ago. These fish were hauled from Monahans, on the Texas Pacific line, 60 miles to some fine lakes near Ft. Stockton. These lakes are now well stocked with fish, and Mr. Roony says that they catch some very large ones. Near Troup, we stocked a lake three years ago, and they are now catching many fish 18 inches long; and so it is all over the state.

And all these good results, arise from the fact that fish were planted, not fry; for I know from experience that if fry had been planted we would never have heard from them again, and I will say right here that I would rather have for stocking waters 100 fingerlings 3 to 4 inches long than 10,000 fry. Where fingerlings are planted I feel sure of favorable results, and very doubtful as to results where fry are planted. While retaining ponds, would be expensive, from the fact that they would have to be of large area, although not very deep, I believe that results would justify them, and I trust some day to see the plan tried. (Applause.)

DISCUSSION.

Secretary Peabody: Perhaps I might mention that Mr. Leary writes in connection with this paper: "I know this will not suit some of my fish cultural friends, as where fry are planted counts sound big, but like many other things, results in the end tell the story."

President: Mr. Leary's paper is now open for discussion. It raises one of the eternal questions. I have no doubt everybody here has an opinion except the president.

Mr. Root: I would like to give a little experience in brief. I went on the Rhode Island commission some twenty-five years ago, and we were buying fry by the thousands and putting them

out. The second year's experience with fry convinced me that we were throwing away our money, and I made an arrangement for raising those trout fry until the following October and then redistributing them; putting 125 fry in a can and carrying them right to the streams, and the result has been that our streams have been stocked thoroughly. We could not stock with fry; it was impossible. We were laughed at all over the country, especially by Massachusetts but we kept on, and we know that it is a success, and I believe it is the only way to stock streams.

President: Any further discussion on the paper? Has anyone a good word for the fry?

Mr. Titcomb: I believe that is a tabooed subject. I am only going to say a few words. We could talk all night on this question and then not get through with it. The question seems to be one partly of finance. When you consider, for instance, the work of the bureau of fisheries, taking the output last spring of white perch, something over twelve hundred million fry, it is practically impossible to consider the idea of rearing them to fingerlings. The whitefish comes in the same category. It seems to be a question of when you can do it, and when not. Some species we know, produce good results with fry. I might give specific instances where brook trout fry and lake trout fry have been planted in ponds, where there were no such fish, and in three or four years good fishing prevailed. The policy of the bureau is to plant fingerlings of trout and bass where possible to do so. But the production is so large and the facilities for rearing to fingerlings so limited in proportion, that it is necessary to plant a large proportion of fry.

In the bass work, we have found that one can hatch in an area of one acre 100,000 little bass. Those little bass feed on minute aquatic life; we cannot feed them; and by the time they are ready for distribution as fingerlings they have eaten each other until the total number has been reduced from 100,000 to anywhere from 5,000 to 15,000. It has been found that in the same pond, by seining out the early hatches of bass fry to the number of say 50,000, and leaving balance to grow to the fingerling stage, it is possible to plant 50,000 fry in suitable waters, where they have plenty of range and plenty

of food; and then two or three months later you seine out just as many fingerlings as if you had not taken out any of them as fry. That has been demonstrated by actual test at one of the pond stations. With the brook trout, it is customary to plant a part of the fish, to relieve the overcrowded condition of the stations, just at the time of absorption of the umbilical sac.

The planting is conducted almost continuously at many of the hatcheries for five or six months after that, the fish being planted as Nos. 1, 2, 3 and 4 fingerlings. It all seems to be a matter of conditions and funds to do with.

President: I should like to ask whether any experiments have been made which are in any way conclusive as to the relative advantages of fry and fingerlings, including the cost of rearing, the total product of the pond, and the results in stocking. I have heard men talk time and time again, and each is positive his way is right. But I have never seen an account of any experiment which really determined it definitely one way or the other.

Mr. Titcomb: It seems almost impossible to make them, because no two streams and no two waters have conditions which are exactly the same. You might plant fry in one stream and not get results, and in another get good results, and in the first stream the fingerlings may produce results.

President: That is perfectly true.

Mr. Titcomb: I think the fish culturists who have stocked these streams for years, can as a rule pick out the streams in which trout fry would produce results, and pick out the streams in which to plant fingerlings. It is a difficult question to consider, taking into consideration the large number of applications and the answers to the questions which are sent to the office on the regular form.

Dr. Tarleton H. Bean, New York City: Mr. Chairman, I do not want to begin a lengthy discussion of this question, but I want to supplement what my friend, Mr. Titcomb, has said about the distribution of fish when the extent of distribution becomes greatly enlarged, as it is in the United States bureau,

and in many of the states. Fish distribution is a very different problem now from what it was when this society first originated. We were then planting hundreds of thousands; we are now planting pretty close to the billion mark, even in some of the states, and the United States has run into several billions, I understand, from its last work.

The question of cost, then, which Mr. Titcomb has introduced, is a very important one, and in fact, it is so important that it must be considered whether you will or no. It is not what you want to do, but what you can do, with the money appropriated for the purpose.

Another thing which I might mention here in favor of planting younger fish than fingerlings, because that is what a great many of the states are doing—what New York is doing now—is, that we escape a great many terrible epidemics by so doing, which would, we know, perhaps three seasons out of ten, sweep the whole product of our hatching establishment. This is another thing we escape by planting the fish early. Suppose there should be an unusually warm season, with little rainfall, it would mean the destruction of trout unquestionably. Now, if you get them out early, you save all this loss. It is nature's way, Mr. Chairman. Nature does not plant full grown fish. She starts them as little fellows out of the egg. It is true she has little devices for taking care of them which we have not; nevertheless, she does not plant full grown fish. There is only one creature that I ever read about that sprang full grown into existence, and that was Minerva from the brain of Jove. We cannot do the same, when we are limited by the amount of work we are called upon to do, by checks on over-production, by the wants of our applicants, by our financial limitations and other surrounding circumstances, and so on. You might go on discussing this question forever; and I think that those who believe they are doing right, saving money and time, by planting fry will plant fry and those that get better results from planting the fingerlings will plant fingerlings.

Mr. Titcomb: I think it proper to call attention to the fact that Mr. Leary's work in Texas has the hearty approval of the commissioner of fisheries, namely about planting fingerlings. It

is due to local conditions that he is able to do it, with the bass and sunfish which he propagates, as he has a tremendous amount of food there. The black bass have been known to grow to about eleven pounds in three years, illustrating the great amount of food that they find, and Mr. Leary can gather any great amounts of natural food in the vicinity of his pond. The fish there at two months of age, I think are two and three inches long.

There is one more point which I want to bring up in connection with the general subject, and that is in connection with the commercial fishes, the perch and whitefish and all of those that are propagated in large numbers,—the shad, for instance. The work of the states and of the bureau of fisheries, consists in saving the eggs which otherwise would go to waste in most instances. It is the saving of the eggs taken from fish netted by commercial fishermen, going to market. This is generally understood by the fish culturist. We might say it would be better to propagate and rear them to fingerlings, but we are trying to save just as many eggs as possible which otherwise would be destroyed—the eggs of fish going to market—and that is the principal work.

President: I am very glad that Mr. Titcomb made those remarks. I had the pleasure of visiting the hatcheries some years ago and considered the work he was doing and also the type of waters. It was quite obvious that the fingerlings—or the ponds in which they went—small lake, shallow water, weedy, and frequently with other fish there ahead, which would eat up the bass minnows put in, with comparatively small chance for the fry to find concealment—that in waters of that kind, the policy which he was following was entirely right. I am not at all convinced it is right for bass with the lakes we are dealing with in our Northern states.

I would like to refer you to one other matter. It seems to me Mr. Atkins paper last year was extremely valuable to this discussion,—showing that the trout fry were able to stand starving for a considerable time, with no apparent injury at all. One of the difficulties which always seemed to me attended the planting of fry was the fact that they were turned loose at a time when there was comparatively little food in the brooks, and it

is evident that nature has adapted the trout fry to that condition of things, for Mr. Atkins has found that they could be starved for an astonishingly long time and come out as those fish did with comparatively small mortality. I must say that his paper encouraged me in his fry theory. We have worked in Wisconsin, partly from choice, partly from necessity; we have certainly found that a great many streams that we stocked with fry, have become rapidly filled up with fish in good condition. The thing I would be glad to have some facts in relation to, is just the question which Mr. Leary raises, that each 125 fingerlings are as good as 10,000 fry. That is something I do not know anything about, and I have not been able to find anybody that knows about such comparisons.

Mr. Seymour Bower: I just want to say a word on the subject. It would depend a good deal on the condition and circumstances and time. Now in our state, we planted brook trout only as fry, and we know that we have had the very best results. We know this, because, as the president stated about the streams of Wisconsin, they contained no trout until stocked with fish in the form of fry. All of the trout streams in the lower peninsula of Michigan, with very few exceptions, contained no brook trout whatever until stocked with fry, and today some of those streams are among the best we have in the state.

There is another point in regard to the planting of fish as fry. If they are held as fingerlings, the distribution is not only far more expensive, but you are almost certain to have a greater loss. Now we can distribute trout fry without any loss during the season, but when you undertake to distribute them as fingerlings, along in July, August and September, hot weather, that is a pretty difficult proposition. You not only lose a good many, but it is far more expensive, and we have firmly come to the conclusion that on even terms of cost, we get greater results—final results—from planting the fish as fry than from fingerlings. In other words, a dollar expended in the form of fry goes further than a dollar with fingerlings. Of course it depends a good deal whether they are properly planted or not. If I were going to introduce brook trout into a pond or outlet of a cold pond, I would deposit fingerlings. But we aim to have our fry

in spring brooks where there are practically no other fish to be found, and where the natural food of the fry in found—in fact where the adults themselves come to pass their spawn, and in this connection I would like to ask Mr. Root if the fish planted by him as fingerlings propagated, reproduced.

Mr. Root: That is a question I cannot answer. I do know that all the streams in Rhode Island have been thoroughly stocked. There used to be from all those streams a good many dams, saw mills, and everything of that kind. Most of those things are gone. The small industries have pretty nearly all gone into the trusts' and capitalists' hands.

But, about the distribution of fingerlings: We don't put out any fingerlings until October and November. Then we buy them, and pay $25.00 a thousand for fingerlings from 3 to 5 inches long, and they are weighed out to us. Now, we put out 125 in 8 gallon cans, that is all we put in, and we never lose any. We send a messenger with them. Of course that is some expense, but the state is willing to pay that for the benefit of the fishermen, and we pay it, and put our bill in, and it is paid. There is no question about it. Of course we are not here to antagonize the government with their billions, but if they would cut that down they would get better results on trout. I don't know anything about anyone else,—that is what we get.

Mr. Bower: The reason I asked that question, was that it occurred to me that if those trout reproduced they must go somewhere to spawn. In other words, have you got to keep your streams stocked, by keeping yearlings all the time instead of having some assistance from natural reproduction?

Mr. Root: That is just what we do, and what we expect to have to do, because most of our streams get very low in the summer, and a good many of them dry up. If we put them in in October or November, we will get fish large enough to catch without any trouble at all. I have put them into a pond—and cut the ice to put them in—as late as December, and a year from that following spring, taken out trout that weighed three-quarters of a pound, plenty of them, it is not an uncommon occurrence. We rarely get one that has been in a little over a

year—from December to the following spring—that does not weigh from half a pound to three-quarters, and I have seen them up to a pound and a quarter. That is a fact. I have been right at it—followed it up for 23 years.

Mr. Meehan: Mr. Chairman, my experience is the same as that of Mr. Seymour Bower's. We found we obtained the best results by the planting of the fry, and that experience has extended over a number of years. And also in regard to the other fishes that Mr. Titcomb spoke about, we have to propagate them in such large quantities that it would be folly to attempt to do that on a smaller scale, and we have also found remarkable results from the planting of the fry of some of the other fishes. Take, for example, the yellow perch. I will just give one example that came to my attention within the last few months.

Year before last we planted a large stock of yellow perch fry in a town in Wayne county, in which that fish did not exist previously. The pond was a large artificial one, intended for a reservoir for the Delaware and Hudson canal, many years ago, and it was filled with pickerel, and what was known as the "shiner," I think, or the roach, but no perch whatever. We made a plant year before last, another last spring, and one this spring. This spring there were good yellow perch fish in that pond. It is a pond we use for getting bait for our bass. The superintendent reported very frequently he caught quite as many yellow perch as he did bait. There was an example of planting fry. These fish were planted within twenty-four hours, sometimes within six hours after hatching at that particular point, illustrating the possibility and the good results that can follow the planting of actual fry.

And the same results followed our trout. Our trout fishing to-day in Pennsylvania is better than it has been for many years. Five or six years ago it was scarcely worth while to go out on a trout stream. To-day the trout fishing is good.

Mr. Fullerton: Mr. Bowers' statement is really the meat of the whole argument. Get them up to the tributaries of the main stream, and you will always get good results. There is no mistake about it. We have tried it in Minnesota, and we have tried a method I think a great deal of. We send the fry

out to the people, especially in the southern part of the state, where the streams run right past the villages, and they make the ponds themselves and turn them out, and they claim they have splendid results. But I know that for the planting of fry, if they are planted intelligently, that is the whole thing—the whole meat in the cocoanut. If you plant in streams where they can get down you will have better results.

Mr. E. Hart Geer, Hadlyne, Conn.: Now I am a firm believer in planting fingerlings, and yet I am liberal enough to believe that where fry are planted successfully and good results are obtained, that that is the best way to do. In Connecticut and mostly all the New England states we find that the fingerlings are the proper thing to plant for trout. In regard to black bass, I will state a little instance. I believe the fry, or, as some have termed it, the advanced fry, are just as good as to rear them to fingerlings. The Housatonic river, which was a noted bass river in Connecticut, was almost depleted of black bass, and the commission planted several thousand of these advanced fry, and reports come to us that in that river the small bass are seen in great numbers. And that seemed to me rather conclusive that black bass planted as fry are successful.

President: A man may be pardoned for his first offense.

Dr. H. M. Smith, Washington, D. C.: With Commissioner Bower's permission. I should like to refer to the question of raising shad in ponds at Washington, which the gentleman who has just spoken has referred to. There were, in previous years, some very noteworthy results from planting shad fry in fish lakes in Washington, and in the fall we turned out many thousands, perhaps millions, of yearling fish. But the recent experience of the bureau of fisheries was decidedly unsatisfactory. We planted in one large pond that had been used in previous years for this purpose, approximately about two million or two million and a half fry—I think it was al out two million—and in the fall we drew down this pond, and as near as I can recollect, turned into the Potomac river thirteen hundred small sunfish, and several hundred Warmouth bass, a few black bass, a few hundred yellow perch, and two or three hundred river herring, and one shad.

(Laughter.) That experiment was repeated another year, with no better results. Now, whether the fault was in the method, carelessness in permitting predacious fish to get in, I don't know. The screens were up, so that as far as we were aware, these young fish must have gone in as fry, got a start, and preyed on the defenseless shad. I believe, Mr. President, the planting of a few million shad fry in the Potomac river would produce equally as good results.

Mr. Titcomb: I want to say we did not have a chance to have a fair and complete experiment. That work was done for a number of years, and it was supposed and reported each year that a number of these five and six-inch fry were turned in, but they were never counted, because handling shad at that age is very destructive, and these attempts were with a view to getting actual results. In each instance the ponds had got stocked from the eggs of Potomac river fry, or other fishes. We learned that the growth of the shad was about six inches. We have the one specimen which we obtained as the result of those plants, which we can exhibit to prove that.

President: Perhaps this shad ate up all the others. (Laughter.)

Mr. Titcomb: I want to ask Mr. Geer one question, whether he knows how many fish, approximately, he has been able to turn out of these ponds from the plants he has made, whether any attempt has been made to get at results?

Mr. Geer: Mr. President, I am surprised at Mr. Titcomb's asking such a question. He just said a few minutes ago it was impossible to count the shad. (Laughter.) Now, then, I will give you some figures of the catch of the adult shad. In 1889, if I remember the date correctly, we had something like three hauls of shad fry from the United States government and planted them in our retaining ponds on the Connecticut river. We did not stop to count the fingerlings as they passed out, although we knew they were shad, as we saw them when they passed out of the gate into the river. They were not sunfish, they were not other fish, they were shad. In four years from that time, the catch on the Connecticut river had reached about one hundred

and seventy-six odd thousand, which was a gain in less than ten years from an eighteen thousand catch; while from that year, from 1889, down to the present time our stocking of shad has been less and less every year, and the catch on the river has been less every year. Now to my mind it proves conclusively the benefit of stocking—of holding the shad fry in retaining ponds, away from their natural enemies, until they have reached three, five or six inches in length, then allowed to go down into the salt water. Furthermore, years ago, before I went on the commission, a great many shad fry were hatched on the Connecticut river and on the Housatonic. A great many were secured from the United States government and planted at Housatonic, thousands more than were caught. And yet, the shad in that river are gone forever, and we cannot get them back, not even with the retaining pond, to be self-supporting. I am thoroughly convinced and believe in the system of the retaining ponds for shad. Our river shows it. According to the number of shad fry you put into those ponds and release in the fall, the catch in the course of three or five years increases.

Mr. Clark: I did not suppose it was possible for me to keep my seat as long as I have when the question of fry vs. fingerlings was discussed. And I do not suppose that any of my friends here thought it was possible. But I have done so, and I have not felt at all like getting up and discussing this question. For twenty-five years this question has come up more or less. I think, if I am right, that I was the first one that ever brought it up before the meeting of the American Fisheries Society at New York City. At that time I was firmly convinced and positive that there was nothing right about planting fry. Like my brother Geer here, I am frankly willing to listen to the fry man,—and, gentlemen, you that advocate planting fry are right; and gentlemen, you that advocate planting fingerlings are right. It is only a question of the fish and the place. Now, this fingerling vs. fry question is discussed from time to time, but we all are of the same opinion still. (Applause.)

Mr. Titcomb: I am not talking this time on the fry vs. fingerling question quite. It seems to me, Mr. Geer's argument on the shad question is not entirely fry vs. fingerlings. It is

more a question of the place where you plant them. He plants his shad fry in some ponds that are free from other fish. I do not think Dr. Smith would have you understand that the experiments of the bureau were entirely satisfactory, or carried to a conclusion. There was some evidence that more than one shad got out of the pond in years previous to those in which we made the count. But I for one, am very sorry that the experiment could not have been continued another year, with the hope that we could have filled a pond with water, without supplying it with the eggs of other fish, and then stocked it with shad, even if we lost every fingerling shad when counting them. I think it would have been a contribution to the fish cultural knowledge of this country, to have destroyed every one of those million shad, if by so doing, to find out the results from planting fry in a pond of that character were definitely ascertained. I hope that the Connecticut commissioners will sacrifice the shad in at least one of their rearing ponds one season, or such proportion of them as it is necessary to sacrifice, in order to ascertain somewhere approximately at least the number of fish which grow up to fingerlings when planted under those favorable conditions. We know that the planting of the shad fry in the various rivers by the bureau of fisheries has produced tremendous results. I understand that yesterday the reasons why the shad fishery has been going down in the last few years were fully explained.

Mr. Geer: I might tell one thing connected with our Housatonic retaining pond. While we sacrifice virtually the shad and know that a great many of them reach the fingerling stage,—to explain that point: It has a long brook which runs into it. That brook is full of pickerel, and when we came to draw it off the year following the October we planted the fry there, we ripped the pickerel open and picked out two to four or six shad —every one of them. We sacrificed that shad. And another is on our Connecticut river, on which we have three ponds there in a chain. In the upper pond there were a great many little fry put in there in the last of August or first of September. There came a cloudburst which raised those ponds to something that we never knew before, and before the superintendent could get

down and take the screens out, the water had risen and rushed over, and brought those little shad, then about two inches long, and plastered them on that screen and killed them all. I didn't count them, but there must have been a million of them. That was a great loss—we so considered it. That was the upper ponds, of course the lower ponds escaped.

President: Any further discussion of this paper? I think Captain Leary's paper has served its purpose of raising a discussion.

EXPERIMENTS IN RAISING BLACK BASS BY TAKING THE NESTS AWAY FROM THE PARENTS AND HATCHING THE EGGS IN TROUGHS

BY EDWARD A. BIRGE, MADISON, WIS.

The facts that I may report are simply these: A year or so ago we lost a very nice lot of black bass eggs in our hatchery at Minocqua, owing to a sudden fall in temperature, and chill of the water. The foreman of the hatchery said to me, "I wonder if it would not be possible to take the eggs from the nests." I asked him to make some experiments on the matter this year. He did so as far as he was able, but had so many fry to take care of that he was able to do only a small part of that work which he and I had planned together, and therefore the experiment cannot be reported on.

The only thing that can be said is that it is perfectly possible to remove the eggs when first laid from nests and to hatch them on trout screens, furnishing healthy fry; but the experiments have not yet gone far enough to warrant any report on the matter at present.

QUESTION BOX.

The first question is as follows: In discussion before the society last year, Mr. Lydell states that he has been reducing the number of adults to the pond ever since he has been engaged in the propagation of fish and gets better results all the time. Does he mean a larger number of eggs per fish, or is it better results from the fry allowed the liberty of the pond? The point is this: Do increased numbers of adults in the spawning pond decrease the production of fry, providing always three hundred square feet is allowed to the nest, as advocated in Michigan fish report for 1903-4?

There are a number of questions here.

Mr. Clark: I would like to inquire who it is from—a member of this society or not?

Secretary: It is from Mr. M. F. Stapleton, of the department of commerce and labor.

Mr. Clark: Is he a member of this society?

President: He is from Mammoth Springs, Arkansas. Mr. Lydell, I suppose should answer, if he is present.

Mr. Lydell: My experience has been that by reducing the number of adults I got a better percentage of eggs from those that do spawn, and get better results from the fry that are to grow to fingerlings. If you get too many fry in your pond you do not get nearly as good results as you do with less, and with your breeders, if you put a few in, you get a few good nests, while you get nothing the other way. In ten of our ponds we put twenty-five breeders and we would get ten or twelve good beds.

President: Twenty-five to what acreage?

Mr. Lydell: The ponds are about 150 x 200 feet. With only fifteen pair of bass in a pond we could get better results than when we had fifty.

President: How many square feet would that be to the nest, in case it was 300 square feet?

Mr. Lydell: You can figure it out. The ponds are about 150 x 200, 15 pair of fish in there.

Mr. Clark: Ponds 10 x 10 to each nest.

President: The next question is: Where all fry are transferred from retainers to rearing ponds, or distributed, what but the spawning area available can govern the capacity of the breeding pond?

I suppose you would say that where the number of bass is large they crowd and disturb one another?

Mr. Lydell: Yes, as I understand. I found one season I had a large number of fish and good results, but have never done so since. I find in late years that by reducing the number of breeders I have had no failures.

President: The next question is: Which method of rear-

ing is looked at most favorably by the small-mouthed breeders, —to transfer the fry to rearing ponds, or give them the freedom of the spawning pond by removing retainers? Is it known that any harm results from netting the fry?

Mr. Lydell: We have had the best results by leaving them right in with the adults. Last season we prepared one pond for a rearing pond. The water was drawn out and the pond cleaned thoroughly, and the vegetation left to come up; then we introduced about 20,000 fry, and did not get near as many fingerlings as in a pond of the same size with fifty old bass. The reason I give for it is that everything got in and ate up the food, and that if I had left the old bass in there to eat up the pollywogs and trash, I would have had the food for my young fish.

Mr. Clark: We remove some of the fry from the spawning pond to other ponds that have no fish in them, and leave about half in the spawning pond. In other words there is about double the quantity of fry in a pond where they have spawned that the pond will take care of; and by so doing we find we can rear just as many as if we did not take any out.

Mr. Titcomb: May I inquire whether you feed them, or do they depend entirely upon the natural food?

Mr. Lydell: We fed them as far as they would take the food. Our ponds to-day are full of small-mouth fingerlings, and the old fish are in with them.

Mr. Titcomb: What do you feed them?

Mr. Lydell: Liver, every day, every afternoon at two o'clock.

Mr. Fullerton: I might say we feed ours at 2:10.

President: Is that the difference in time between the two stations? (Laughter.)

Mr. Carter: I should like to ask Mr. Lydell if he had any difficulty in teaching his black bass to eat liver?

Mr. Lydell: To a certain extent, we do, but they come to it after a while. Our liver is cut up into strips about as large as a pencil and two inches long, and they feed every day. There is

not a day, except when it is very cold, but what they will come up and feed. I took a number of bass, and quite a number of them had crawfish and liver in them. I took them out after they were fed, to see if they had taken the liver. But you will find it takes about two weeks to get them to feed on liver. We feed in one place, and keep continually at it. But they do come.

Mr. Carter: I should like to ask Mr. Lydell how he keeps up his supply?

Mr. Lydell: We introduce new bass every season—a few—out of our stock pond. This season I think we lost six adult bass.

Mr. Carter: Do you get better results from the bass you introduce each spring?

Mr. Lydell: I get better results from the old ones.

Mr. Carter: I have had the reverse. Each spring we have been obliged to replenish the stock by taking them from Lake Champlain and transferring them to St. Johnsbury, and almost all of the fry shipped out from St. Johnsbury have come from eggs of fish taken from Lake Champlain the same spring, and the fish held over from one spring to another yield a very small quantity of eggs.

President: Are you able to feed these fish that are held over?

Mr. Carter: Yes, during the first part of the season we are. We feed them on shiners, small perch and other fishes of that character taken from a nearby stream, but later in the season the food supply falls off.

Mr. Titcomb: May I ask a question as to that particular feature of the paper—as to the advisability of feeding shiners to the brood fish while the fry are still in the ponds?

Mr. Lydell: Something we never do is to introduce a live minnow in our bass ponds before or during the spawning season. I have known them to clean up a whole pond of fry by having them in there. There are so many weeds that the old bass can-

not catch the shiner or chubs or whatever they may be, but they can lay around and get the fry. For the last two years we have not introduced a live minnow into our ponds during the spawning season.

Mr. Carter: I have recommended to the Washington office that they construct at St. Johnsbury one large bass pond in which all the bass are to be held during the periods when they are not spawning; and my recommendation is that in the spring of the year before the fish are ready to spawn they be sorted out and transferred to a medium class of pond, measuring 25 x 75, or about that area. Then my idea, as soon as the spawning season is over, is to take the bass and put them back in the stock pond. My idea is to make that pond as large as we have room for at the station, and to keep it well stocked with coarse fishes and during the time they are out of the pond the food will be collected, and when they get back they will find food, and there will be none of the coarse fishes in the spawning pond, and the young will be allowed to grow without being molested.

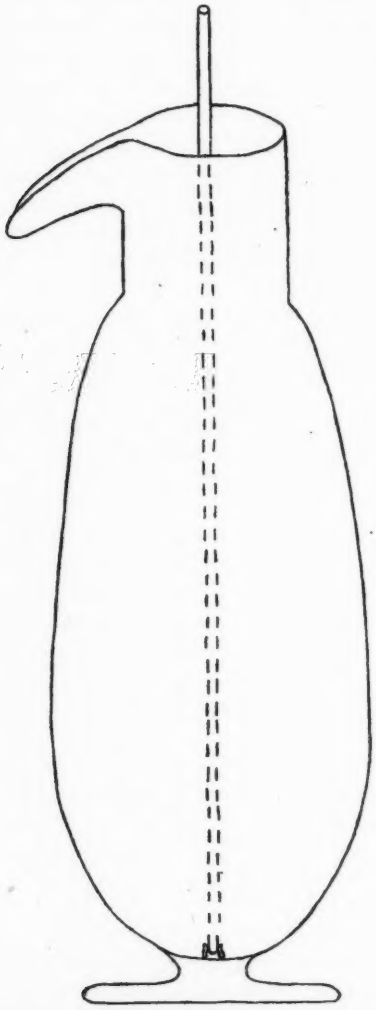
NOTES ON A NEW HATCHING JAR

BY FRANK N. CLARK, NORTHVILLE, MICH.

Of the various open top jars heretofore invented, but little attention or consideration has been given to the formation of a jar so shaped that in operation it would be automatic to the extent of separating the live from the dead eggs. Believing the construction of such a jar to be entirely feasible and within the limits of probable success, experiments were undertaken, the final result of which has been the successful demonstration of a new form to be designated and known as the Clark Hatching Jar.

In briefly describing this improved form, it would be stated that the bottom is identical with that of the Downing jar, and also it has the same outline for about one-third the distance up the sides. It is then gradually drawn in or made smaller, until it ends in a straight and comparatively narrow neck some four inches in length. On one side of this is the glass overflow, which is nearly twice as long as that on most forms. In the Clark jar one of the objects sought has been to have it so shaped that the currents of water would cause the good eggs as they came to the top, to be thrown inward and downward toward the center, while the lighter and poorer eggs would instead go to the surface, where they would be easily removed, or else would run off of their own accord. In other words, the idea was to perfect a jar for the handling of whitefish eggs which would be as nearly automatic in this respect as possible. The objection to the usual form of Chase or Downing jar has been the requirement of a considerable amount of labor for drawing off dead eggs, and also there is always the chance that quite a number of good eggs are unintentionally drawn out during the operation of using the siphon. However, the necessity of thus daily attending to the jars has never been questioned, for if not drawn off there was great danger of the fungus settling and mixing with the good eggs in the lower portions of the jar, thereby causing serious loss, and also inconvenience in handling. With these disadvantages in mind, it was set about to devise a new jar which had a current with a tendency to lift out the larger inferior eggs, or

at least make quite improbable the chance of their settling, and at the same time retain the good eggs. With such an improved



CLARK HATCHING JAR

form of jar it was thought that there would not only be a saving of eggs, but of labor as well. The result of study and investigation along these lines has been the formation of a jar as herein described.

The new jars were used throughout the winter hatching season at Detroit, and in operation they worked even better than had been anticipated, for the poor eggs separated very readily from the good, and it was only every three or four days that a siphon was put in to assist in completing the separation. This was not necessary by any means, but was merely done to somewhat hasten the final "cleaning up". An evidence that the use of a siphon was not required, and to show how nearly automatic this new form really is, it can be stated that one jar was never touched from the time the eggs were put in during November until a few days before they hatched the following April. As the eggs fungussed they rose to the top, and while some passed out, the most of them formed a mass which became attached to the tube near the upper end, and remained there until poked out with a feather just before hatching. The remaining eggs were of excellent quality, and it is firmly believed that this jar which was left untouched throughout the winter, produced more fry than did those which were frequently drawn off with a siphon. Of course the plan of leaving this mass of fungussed eggs in the jar for three months or more is not to be recommended in general practice, but it shows what can be done in the way of obtaining a jar which is virtually automatic. In actual use on an extensive scale, it is thought that the best plan would be to simply use a feather every few days in going over the eggs and break loose any bunches that might form, thus permitting them to pass out. Or if not yet fastened to the tube or neck of the jar, the slight additional aid occasioned by touching with a feather would be sufficient to cause the bunches of fungus to flow from the jar. Comparing this method of attending to the jars with that of daily drawing off with a siphon, it may readily be perceived that the saving of labor in favor of the improved form and method is worth careful consideration.

The increased length of the lip or overflow is thought to be of considerable advantage over other forms employed, as in using the Clark jar the water is thrown well over into the receiving

trough, with no trouble of running down on the outside, which difficulty has been sometimes experienced with the Downing or other jars. The only objection noted so far to the Clark jar is that its capacity is not quite as great as that of the other forms, but this can be remedied by having the size increased to hold at least 200,000 whitefish eggs, being careful to retain the same lines and proportions. A rough sketch of this jar drawn on a scale of one to four inches follows herewith.

DISCUSSION.

While reading his paper Mr. Clark made the following comments:

(1) Of course the current of water does that.

(2) I would say that the fungus or bunched eggs will not settle. That jar has run this winter, and there was not a single time where it was found that they would settle and go down in here (indicating)—a bunch of eggs.

(3) New jars were used throughout the winter, 625 of them.

(4) One jar (and that is the identical jar) was not touched at all. I mean there was nothing put in the jar whatever to remove any egg; neither siphon, feather, or anything else; nothing put in the jar for taking the eggs out.

(5) I would say the good eggs were from here down (indicating).

(6) This (indicating top of jar) will not be made any larger. It is proposed to make this (indicating) central portion an inch larger in diameter.

At the close of his paper, Mr. Clark said:

I would say, in addition to what I have read here in my notes, that there is no question at all but what that jar set up in a hatchery with whitefish, will simply run by itself. And in passing I wish to say this, that we have just lately found out, at least I think so, that on the whitefish matter—of course we have been hatching quite a good many years—but I think all these many years we have been working our whitefish eggs too much, even in any jar, I don't care whether it is the Chase jar, Downing jar, Meehan jar, or any other jar; we have been drawing off our eggs too much. I think we have lost good eggs, not any very

great per cent, but we have lost eggs by doing so. Too much attention has been paid to them. Here is a jar, with the fungus formed on there, and the foreman said that jar had stocked as good or better than any other jar we have. I think with that jar one man can take care of between 1500 and 2000 jars. We had in Detroit 1400 jars, and it is proposed this next winter that our labor during the day will be cut right square in two. (Applause.)

Mr. Fullerton: May I ask Mr. Clark a question? Would that apply to the white perch?

Mr. Clark: I would say that we did not try the white perch.

Mr. Fullerton: What is your judgment?

Mr. Clark: I will tell you better next year.

Mr. Fullerton: We do not hatch anything but white perch in Minnesota, and I would like to know.

Mr. Clark: I want to say this: that I am claiming this, that that is the only automatic jar.

Mr. Geer: Where can you get those jars?

Mr. Clark: You can probably have them made. There is no patent, and if anybody wants to use them they can probably have them made; there is no patent.

Mr. Thayer: Both jars will be made by C. Dolfing & Sons Company. And if this drawing Mr. Clark has is not satisfactory for printing in the report, I have no doubt one can be furnished in the office.

Mr. Clark: They have this same thing, and it will be necessary for us to have one in making the jar a little larger in diameter. It is very possible that this jar will be made on a mould. Heretofore the Downing jars and the others have not been made on a regular mould, and have not been uniform; some working a great deal better than others.

Prof. Smith: It seems to me this jar represents a tremendous advance in the methods of whitefish culture, if the jar accomplishes what Mr. Clark claims for it.

Mr. Downing: I would like to ask Mr. Clark what becomes of the eggs that flow over.

Mr. Clark: They flow into the trough.

Q. And then out into the tank?

Mr. Clark: Into the tank, if you please. In the Detroit plant the eggs flow into the tank and into the end. (Indicating.) It is the double battery system, and they flow to the other end, and air enters the tank at the cross section.

Q. Doesn't it ever plug any of them?

Mr. Clark: No reason why it should.

Q. No water can get down into your trough?

Mr. Clark: Then your hatchery is not run right. He should have another system for pumping his water out. What did you say was the reason of the eggs running in?

Mr. Downing: If the water should run down that would naturally create a suction.

Mr. Clark: And draw the eggs in a mass of fungus?

Mr. Downing: There would be no mass of fungus in your trough.

Mr. Clark: In the whitefish battery we have two systems. You have one here—Mr. Downing, I think has one here. You have got the Alpena system. In Detroit we have the double battery. All of you have either seen it or have read the desciption of it in the Fish Cultural Monthly. The water passes down into a trough. That trough does not feed your lower jars. This trough comes down to the other end. Your water is not going to run down; the eggs are not coming in to stop your faucet, because the eggs are down in your other trough.

Q. And do not pass down through the supply trough at all?

Mr. Clark: Not at all, unless they get too many. Of course they should be drawn out with a siphon. Those troughs should be cleaned out in every hatchery once in a while, according to how much there is in.

Mr. Carter: I should like to ask Mr. Clark about that tube. Is that the one with the three little feet at the bottom?

(Mr. Clark exhibits tube with the three feet at the bottom.)

Mr. Carter: I have used this at Swanton, Vermont, this same tube with these three little feet at the bottom (speaking of pike perch work). I always found that these feet checked the current of water, and the eggs are very apt to settle in the jar and not have very good movement. Have you ever had that trouble?

Mr. Clark: Caused on account of the feet?

Mr. Carter: Yes.

Mr. Clark: No sir, never heard of it.

Mr. Carter: Have you Mr. Downing?

Mr. Downing: My tube sits in a jar and a rubber tube goes down into it a sufficient distance, and the rubber tube is small enough so that there is a small circulation of air. And the business of the fish culturist is to move that tube a little, so that if any thing should catch on the teeth, it is liberated.

Mr. Carter: The reason I ask is, that in our jars at Swanton, we had those same tubes, with pike perch eggs. We had a great deal of trouble with the tube checking the flow of water, and the movement of the eggs in the jar. I had a new tube made, by taking off the little legs of the old ones and soldering a funnel on the opposite end. The tube was then self-centering; if the top of the jar was perfectly true, these tubes would center—we had no trouble at all—just dropped them in place and the funnel would center in the top of the jar. We used the McDonald jar, and we had no trouble. By driving a tapering piece of wood into the lower end of the tube, the latter was flared, giving the bottom tube a slightly bell shape and we had a very much better flow of water. This tube was always in the center; while I found with the others that the tube was not always in the center, that it sometimes hung one way and sometimes another. The only trouble with the funnel was we could not get the siphon down into the jar very easily—would have to

raise the funnel up. Finally I made the funnel itself in the shape of a cross, thus allowing apertures between the junction of the cross pieces for the insertion of the siphon.

Mr. Clark: Mr. President, may I ask Mr. Carter—you say a funnel in here? (indicating).

Mr. Carter: No, funnel at the top.

Mr. Clark: You mean a funnel shape?

Mr. Carter: An ordinary funnel, just a little larger, half an inch larger in circumference.

Mr. Clark: May I ask what it was for, to hold the tube up?

Mr. Carter: Yes. The water was allowed to flow with the little rubber tube, the funnel had half an inch of water, and the funnel was below that, so no air could get in at all?

Mr. Fullerton: Mr. Clark, is that the working size of your tube?

Mr. Clark: Yes sir, that is the tube itself, that was in use.

Mr. Fullerton: You put a rubber tube attachment on that?

Mr. Clark: The faucet is here (indicating) and the rubber tube goes inside here, below the water.

Mr. Fullerton: We work it the opposite. The rubber tube comes on the outside,—used the glass tubes.

Mr. Carter: The old jar at Swanton ran very unevenly, and for that reason the funnels did not always feed well, but where they did that, the funnels centered themselves, the tube being a little heavier sought its own center, and those jars worked beautifully.

Mr. Titcomb: I want to get at the difference between Mr. Clark and Mr. Johnson. In the first place, what does that tube cost?

Mr. Clark: Mr. Thayer, can you tell what these tubes cost by the thousand?

Mr. Thayer: I think about four and one-sixth cents.

Mr. Titcomb: The other costs about nine or ten. I wanted to get at the difference. Have you had any trouble with the tube not centering properly at the bottom?

Mr. Clark: I will ask Mr. Thayer.

Mr. Thayer: No sir, we have them feed properly.

Mr. Titcomb: That is for either pike perch or white fish?

Mr. Clark: Yes sir.

Mr. Titcomb: You never had this trouble that Mr. Carter refers to?

Mr. Clark: Yes, lots of it, but not caused by that tube.

Mr. Titcomb: I would like to have you explain to Mr. Carter what he wants.

Mr. Carter: I can explain to Mr. Clark that it is the tube. Where these three feet are, there is a checked flow of water, in which the eggs do not move. There is a V-shaped mass of eggs beginning at the bottom, where the feet are, and gradually extending to the top of the jar.

Mr. Clark: I would like to ask Mr. Carter, if he knows positively it is not some sediment of some grass that hangs on, that does that?

Mr. Carter: I know that.

Mr. Clark: You know that it is not. You know it is nothing but those feet?

Mr. Carter: I know it is nothing but those feet.

Mr. Clark: Then I have nothing to say.

Mr. Carter: I will ask Mr. Fullerton.

Mr. Fullerton: We had the same experience that Mr. Carter did, and threw the things away.

Mr. Clark: May I ask Mr. Fullerton, how he keeps his glass tube from the bottom.

Mr. Fullerton: Simply by cutting the rubber.

Mr. Clark: It hangs? Mr. Wires, how long ago did we use the tube you run here, and let it hang?

Mr. Wires: In 1883 or '84.

Mr. Carter: As I understand it, the rubber suspends the tube.

Mr. Clark: Yes.

Mr. Carter: Of course you couldn't suspend the tube without a perfect curve. What I say is, that the funnel centers the tube; if the top of the jar is perfectly round it holds the tube just exactly the right height, about a quarter of an inch from the bottom of the jar.

Mr. Titcomb: Mr. President, I am sorry that these gentlemen cannot find out what the trouble is with their tubes.

Mr. Clark: No trouble with my tube.

Mr. Titcomb: There seems to me quite a little evidence to confirm Mr. Carter's theory that it is not entirely satisfactory. I was trying to get at the trouble, because evidently it is a difference in the method of manipulation. Some have mentioned the use of glass tubes, so I will say in that connection that we use at some of the stations the glass tubes suspended, at shad station, where we find it desirable to use the McDonald jar, with closed top, to propagate shad. At other times, in order to use the same jar with open top, we have the metallic ring, with pitcher nose to it; and the same glass tubes are used, by building a frame over the row of shad jars, simply a frame of wooden strips about three inches wide, suspended a little ways above the jar and held in place with wedges. In connection with the jars, and over each jar, there is a hole the size of the glass tube, or a trifle larger, through which the tube is inserted, and then the little rubber gasket which is used with the McDonald glass tube, is used on this wooden frame work, and that is the method of suspending the tubes, while operating a large number of open-top jars in the series.

Mr. Geer: Mr. President, may I ask Mr. Clark what the advantage of that tube is over the glass tube?

Mr. Clark: I am not saying that there is any, Mr. President, I am not. That tube has nothing to do with my paper. I will take it out. (Laughter.) This is the tube we use at the station, and it was perfectly satisfactory to us. Those that want to use glass tubes, why use glass tubes. Of course, you will all remember, if you have ever seen Mr. Chase's patent papers, they provide for a glass tube, way back in 1880, the first jar they invented, in the patent papers, provides for glass tubes. I suppose Mr. Fullerton has those same tubes.

Mr. Fullerton: Never saw one.

Mr. Clark: The original glass jar was invented by Mr. Chase, and that jar in the patent papers, I think provides for a glass tube. Now, all these others have been taken from that. Mr. Chase had on his glass tubes the little feet here, but of course they were not as thin. The thing that I feel a little funny about is how can a very thin thing like that stop the flow of water, to make trouble with the eggs. That is the only point. It seems to me it must be something else that makes that, with the pike perch, I should say—Mr. Thayer is more familiar I should think it was the chunks of fungus and the eggs, isn't that it?

Mr. Thayer: That is all we found.

Mr. Clark: And does not effect the eggs so that they shoot up here and there. It is the mass of fungus in there with your pure eggs. But if the glass tube is what one man wants, let him have it. One man may use tin, another lead, or something else. In the Detroit hatchery, we used to use lead—isn't that right Mr. Bower?

Mr. Bower: Yes, sir.

SOME OBSERVATIONS ON EUROPEAN FISHERIES AND FISH CULTURE*

BY HUGH M. SMITH,

Deputy U. S. Commissioner of Fisheries

Marine culture.

The cultivation of marine fishes in Europe is on a comparatively small scale. As it is a form of pisciculture which private individuals are not willing to undertake, and as government work of this kind is the exception rather than the rule in Europe, but little attention has been given to the increase of strictly salt-water species. Furthermore, there is considerable skepticism among biologists and fishery authorities as to the value of fish culture as applied to the sea, and the limited work now carried on is far from being regarded favorably.

The most extensive and celebrated of the European marine fish-cultural establishments is that near Arendal, in southern Norway. This was started in 1884 under Captain G. M. Dannevig, who was thus a pioneer in practical marine fish culture; this work began in the United States in 1886, and was to a great extent influenced by the Norwegian methods. I saw manuscript letters written by Professor Baird to Captain Dannevig in 1884-6 asking for particulars as to the apparatus and methods of cod culture. We have now developed other methods and appliances, but from what I was able to observe I am inclined to believe that the old Norwegian methods are decidedly better in some respects. The hatchery operations have of late years been addressed exclusively to the cod, and have been quite extensive, the number of fry turned out in the past fifteen years being considerably more than 3,000 millions. The hatchery was originally constructed by the Society for the Promotion of the Norwegian Fisheries, but is now maintained by the general government, which makes an annual grant of 10,000 kroner ($2,500), recently reduced to 7500 kroner ($1,875).

Following are the salient features of Norwegian cod culture:

(1) The brood fish are bought from the market fishermen

*Based on personal inquiries in 1905.

and are kept in a large artificial pond high above the level of the sea. The pond accommodates 1,500 cod averaging 7 or 8 pounds in weight; during the season of 1905 there were 500 fish on hand, of which only one-tenth were males. The pond has a sheet-iron roof, and no direct light reaches it. It is 15 feet deep, with a false bottom of wooden slats, through which the debris passes to the real bottom, whence it may be drawn off by opening pipes.

(2) The brood cod are fed regularly from the outset and remain in sound condition, although they lose weight. The best food in lean fresh herring, but fat herring, salt herring, and other fish may be used. The darkened pond prevents the loss of sight which is so common in fish confined in shallow live-cars in the open air.

(3) The characteristic and very important point in the operations is that the cod are not handled at all, but are allowed to spawn naturally. Spawning takes place from 9 p. m. to 1 a. m., and practically all the eggs are fertilized. The eggs come to the surface, and pass out of the pond through a broad, shallow overflow into a flume which leads to a special house, where the bottom of the flume is covered with silk-mesh screen on which the eggs are left as the water passes through. The eggs are gently scooped up and transferred to buckets or tubs of salt water the density of which is gradually reduced, so that the eggs will sink while the oily refuse remains at the surface and may be poured off. The eggs are next measured, 450,000 being allowed to a liter (our figures are 337,000 to a quart, or about 346,000 to a liter—a discrepancy of 104,000, or 33 per cent, which the fish culturists must explain), and are then placed in the hatching boxes, 1 to 1½ liters to a box. The largest number of eggs taken in one season was 1,440,000,000; in 1905 the number was 363,000,000, an average of something over 800,000 per fish.

(4) The hatching apparatus is essentially the same as our automatic tidal box, most of the differences in construction being in favor of ours, in my judgment, although of course Captain Dannevig is firmly convinced that his is the most effective. The hatching season begins in February and continues till May. The maximum number of eggs that may be incubated at one

time is 200,000,000, but more than 400,000,000 may be handled in a season; and, as a matter of fact, 412,000,000 fry were planted one year. The average cost of the entire operations is less than one cent per 1,000 fry planted. The water density varies considerably, and exerts an influence on the work. The maximum density is 1.027, but sometimes large quantities of fresh water are discharged from the Baltic Sea, and the density has fallen as low as 1.014. This is fatal to the success of the hatchery, as the eggs will not float and can not be gotten out of the spawning pond. The young are kept in the hatching boxes four or five days before planting; by that time they have become much stronger and hardier than when a day or two old.

(5) Captain Dannevig has established the fact that individual cod spawn annually. He has kept brood fish in ponds five years, and has gotten eggs from them each season. The fish thus kept at the station, being fed regularly, remain in good condition and their ovarian development seems to be greater than in wild fish. Captain Dannevig says there is as much difference between them and wild cod as between a Yorkshire hog and a wild boar. Immense numbers of eggs have been yielded by some of these domesticated cod.

Lobsters.

The Norwegian lobster fishery is more important than that of any other European country, although the abundance of lobsters has greatly decreased in recent years. Many years ago the hatching of lobsters was carried on at Arendal in conjunction with cod hatching, Captain Dannevig having been the pioneer in the artificial propagation of lobsters. For a long time lobster hatching has been abandoned because of the absence of appreciable results and the general unpopularity of marine culture; and only experimental work, in the line of rearing, has been carried on. The experiments have been in charge of Dr. Appellöf, of the Bergen Museum, who informed me that he had got some rather promising results and will continue the work on a larger scale. He does not attempt to hatch the lobsters, but keeps the brood females in live boxes and lets them hatch their own eggs. The larvae are collected and transferred

to rearing boxes; these are about 2 feet square and 3 feet deep, with a latticed top and with sides and bottom formed of a fine, strong, black scrim. Such boxes, which will accommodate 8,000 to 10,000 larvae, are moored in rows between rocks or stakes in protected bays, where there is wave movement but no heavy seas. It is reported that owing perhaps to the lower temperature of the water the development of the larvae is apparently considerably slower than in America. My personal opinion is that the absence of a well marked and sustained circulation within the boxes decidedly impairs the chances of success.

Sturgeon and Shad.

The sturgeon fisheries of Russia are more important than those of any other country; and it is only in Russia that sturgeon cultivation is carried on. Mr. Borodine, the Russian chief specialist in fish culture, told me that several million sturgeon are now hatched annually on the Caspian Sea, the species being the one he recently described. There is difficulty in holding the young for any length of time. With other species the great drawback encountered is the same which we have to contend with, the inability to find ripe fish.

In connection with Mr. Leary's efforts to acclimatize shad (and other fishes) in a salt-water lake in Texas, I may mention the existence, in some of the Italian fresh-water lakes, of a naturally landlocked shad (*Alosa vulgaris* var. *lacustris*). Mr. G. Besana, of Milan, the gentleman who has achieved such marked success in the acclimatization of our black bass and sunfish, has the cultivation of this lake shad under consideration, and has been making some observations on the fish's habits preliminary thereto. It reaches a length of a foot, but the average size is several inches less; the anadromous form is much larger, comparing very favorably with our shad in size. The lake fish is very palatable, and is said to be superior to the seagoing form in food value. The spawning period is the first half of June, and the eggs are deposited mostly in the evening, although there is a secondary spawning time about four or five in the morning. The fish come from the deep waters of the lake to spawn, and then make a loud splashing noise about the shores. For three years immense numbers have been dying in

May and June; the fish are well-nourished and apparently sound, and the cause of the mortality is not known, although Myxosporidia have been suspected.

Salmon.

The cultivation of the Atlantic salmon in Norway is conducted at several large government stations, and the work is very popular. More dependence, however, is placed on legislation than on artificial propagation to maintain the supply; a new law, which went into effect in 1905, has a prominent feature in a close-time on net fishing from Friday to Monday. As is well known, Norway is visited by many anglers from England and other European countries, and the best salmon streams are in great demand. For example, on the Lardal River the land owners, mostly peasants, now receive $10,000 to $12,000 annually for the angling privileges, and obtain also many indirect benefits. In northern Norway there are valuable salmon waters that as yet are practically untouched, owing to their remoteness and the absence of markets; but along the western and southern coasts depletion has occurred and replenishment has not been effected. In these circumstances, the Society for the Promotion of the Norwegian Fisheries—a semi-official organization—is considering the introduction of the humpback salmon of our Pacific coast, and has been in correspondence with the fishery department of the State of Washington. I was questioned in regard to the game and food qualities of the humpback, and was informed that probably 500,000 eggs would be obtained this season as the initial step in the attempted acclimatization of the species. The physical characters of the Norwegian coast are very similar to those of Alaska, where the humback abounds, and the introduction of this fish should prove successful.

Fish Transportation.

In Vienna I saw a number of demonstrations of the fish-transporting device, patented under the name "Hydrobion", about which there have been several notices in the American press during the past few years. Any form of vessel may be used, but the standard furnished by the inventor is an elliptical

tub 3½ feet high, 2½ feet long, and 15 to 18 inches wide. The essential feature of the apparatus is a small cylinder containing oxygen under a pressure of 120 atmospheres, the escape of the oxygen being regulated by a valve. The cylinder is fastened to the bottom or lower side of the vessel and the oxygen comes off in small bubbles. The cylinder is made in five sizes, adapted to the size of vessel used, the length of the journey, and the number of fish to be transported. For any cylinder, the escape valve may be so adjusted that the liberation of the oxygen will continue during the entire anticipated length of the trip. It is claimed by the inventor that a tank of two-year-old trout, say 40 to 50 fish, will carry without loss in moderate weather for 48 hours. The cost of the outfit, with five cylinders, is $100, at which price there must be a very handsome profit.

The fishes I saw experimented with were brown trout up to a foot in length and carp up to a foot and a half in length. The tanks were in the open air, and the temperature of the air was 80° to 85° F. Both lots of fish seemed to be suffering, as they came to the surface repeatedly and showed labored respiration. A thick scum continued to form all over the surface, and had to be removed by an attendant from time to time; whether this was due to the green, uncoated tanks or to the water I do not know. My impression was that perhaps the oxygen reached the fish in a too concentrated state for their needs. An Italian fishculturist told me that he had found the apparatus useful and efficient in transporting bass and sunfish; and that the cylinders could be recharged (in Rome, for example) at an insignificant cost. This same gentleman had recently met a Berlin engineer who claimed to have perfected an apparatus which, by liberating ozone in the water, permits the transportation of fish in remarkably small quantities of water. Thus trout eggs may be carried in a vessel containing only as much water by bulk as trout, while carp may be safely transported in a vessel containing 78 per cent fish and only 18 per cent water. The inventor has hopes of being able to carry live salmon from America to Europe on the regular ocean steamers.

Austrian trout-breeding establishments.

In conjunction with the Fishery Congress in Vienna, visits were made to a number of private trout-breeding establishments in lower Austria. These visits proved very interesting, enjoyable, and profitable to me; and I will venture to tell you something about the hatcheries, their methods, and their products.

Here, as at most other places in Austria and Germany, the American trouts are handled, and give very satisfactory results. The rainbow trout is the most general favorite, owing to its hardiness, rapid growth, and all-round good qualities.

I was very strongly impressed with the methods of feeding in vogue at all of these stations, although I have not sufficient knowledge of practical fishculture to judge whether the Austrian practices are unknown or unused among us.

In the first place, great stress is laid on the value of natural food for young trout, and much attention is devoted to its production and administration. Certain ponds, together with ditches and moats, are kept well stocked with water plants, and such waters are used as reservoirs for copepods, which are collected with fine-meshed nets as needed. In addition to this, piles of compost are placed at intervals around the borders of the rearing ponds, the compost being the material taken from the bottoms of ponds and left to dry on the shores for several years. The use of compost in this way is based on the theory that there is secured an abundant development of bacteria which serve as food for the copepods. At one station a very shallow pond covering about an acre had been drained and when dry had been thickly sown with peas and grass, which growth when 6 to 12 inches high was killed by flooding the pond. It was expected that in a short time decomposition of the vegetable matter would begin and bacteria and copepods would appear in large numbers; then young trout would be introduced. This was an initial experiment, and some of the visiting fish culturists with whom I talked expressed doubt as to the rationale of the procedure.

Another food in general use was found to be the salted eggs of the cod. These come from Norway in barrels holding several hundred pounds, and are prepared primarily for use as bait in

the French sardine fishery. The eggs are soaked in fresh water before using, and their small size makes them available for the youngest trout. In feeding, care is exercised to prevent the young trout from gorging; in other words, the food is given in small quantities, and the feeding periods are prolonged. The manner of automatically administering food to the young was new to me, but may be well known to some of the members of the society. In the case of copepods, ordinary terra-cotta flower pots are suspended from a rod supported by two stakes driven in the bottom of a pond or sluice, the top of the pots being an inch or two above the surface of the water; in addition to the hole in the bottom of the pots, three to five holes are made in the side near the base. When a dipperful of copepods is put into one of these pots, the tiny creatures gradually pass out and are seized by the waiting trout. One pot will thus be a reservoir which continues to discharge its contents for 20 minutes to one hour.

Cod eggs are administered in a similar way. They are mixed with water in large wooden or metal buckets or tubs in the bottom of which are several circular holes into which short pieces of rubber tubing are inserted, the size of the holes and tubing being such as to secure a small, steady outflow. These vessels may rest on a plank or be suspended from a stake, the ends of the tubes a few inches above the surface of the pond; and are set near the inflow, so that the food will be scattered by the current. Some of these feeding buckets which I saw in operation will discharge for an hour or more without alteration.

Mr. Franz von Pirko, the president of the Austrian Fishery Society, has a large estate at Pottenbrunn, and on it is an excellent trout-rearing plant. An abundant—practically unlimited—supply of fine spring water enables him to maintain many ponds and sluices, and to provide plenty of room and natural food for the growing trout. At present the establishment comprises 20 nursery and rearing ponds and 24 so-called nursery ditches, with a total area of 38,000 square meters, in addition to which there are 12 kilometers of spring brooks stocked with fish. The nursery ditches (Brutstreckgräben) are very narrow, shallow water-ways, with considerable current and well supplied with growing plants, in which the trout are placed

immediately after the absorption of the yolk-sac. The fish are not allowed to roam freely in these ditches, but are confined in live-cars 5 to 7 feet long in which there are natural conditions —that is, plants, sandy bottom, and hiding places.

The principal species handled are *Salmo fario, Salmo irideus,* and *Salvelinus fontinalis.* The average yearly egg-take of late has been 200,000 eggs of the native trout, 100,000 eggs of the American brook trout, and 100,000 eggs of the rainbow trout. The loss during incubation is 10 to 15 per cent and during the yolk-sac period 5 to 8 per cent, so that the annual output is about 300,000 fish for planting in the rearing ditches. The annual sales of market fish are now about 4,000 pounds, for which 70 and 75 cents a pound are received from dealers, the retail consumer paying from 80 cents to $1.00 a pound.

According to a descriptive booklet issued by Mr. von Pirko, the aims of the establishment are (1) to produce healthy brood fish in natural waters; (2) to produce healthy well-colored yearling fry for market, the method of their rearing based upon exact knowledge of their habits and necessities; and (3) to produce rapidly growing edible trout in running water and in ponds by consideration of all the factors of natural existence and food.

At Wagram is a rather extensive plant, established in 1868, forming part of a large estate and being sub-let to a practical fish culturist. When I entered the grounds, it was difficult to realize that I was not in America, for practically every pond contained American trouts, as shown by the conspicuous signs. Here I saw *Salvelinus fontinalis, Salmo irideus, Salmo clarkei* and *Salmo gairdneri.* Among the fish on hand June 10 were 20,000 yearling brook trout, 50,000 yearling rainbow trout, and 300 large breeders, 400 two-year-old black-spotted trout in fine condition (the original stock from Jaffe at Sandport), and several thousand excellent steelheads about two years old, together with some hybrid steelheads and native brook trout *(Salmo fario).* The proprietor sells some fish for food in the Vienna market, but his principal business is in yearlings for stocking purposes; for such fish the prevailing price is $28 per thousand.

The conclusions I reached after inspecting these and various other establishments were that some of the practices are worthy

of adoption by us, but that the methods as a whole are not adapted to the wholesale operations of our hatcheries.

DISCUSSION.

During the reading of his paper Dr. Smith made the following comments:

1. There was practically an unlimited supply of fine spring water.

2. Referring to figures, Dr. Smith said: These are very small figures, compared to American figures.

Referring to the size of the pond, President Birge said: That is about 38 hectares.

Dr. Smith said: 38,000 square meters.

President: That is a pretty large area.

Dr. Smith: He has an immense estate there.

President: That is a hundred acres to a pond.

Mr. Smith: I may say that this man is wealthy, does not have to engage in this business; it is a pastime with him. Nevertheless, he sends fish to the market.

3. This method of transporting yearling fish in relatively small portions of water is perhaps worthy of consideration by this society. The Japanese are most adept in fish matters and are able to carry gold fish and other delicate forms of fish, practically without any water.

I have seen shallow tubs of gold fish carried on the shoulders of a Japanese for a distance of more than a mile in broiling sun, with no covers over the tubs and the fish at no time submerged. The fishes were moist, squirming all the time and got plenty of oxygen. Whereas, if those fish had been fewer in number, and the water more abundant, and the water had become superheated by the long distance in the broiling sun, the chances are, the fishes would have died. I may say that same methods have been employed by one of the leading Japanese gold fish culturists in transporting gold fish to this country. He recently arrived in New York, and Dr. Bean told me that was the method he em-

ployed. Does Dr. Bean remember how many fishes he started with and how many he lost?

Dr. Bean: He had a three weeks sea journey, and nearly a full week of rail journey, and lost only 30 per cent. He brought 800 alive to New York.

Dr. Smith: These were adult fish?

Dr. Bean: A large percentage of them were adult fish—about one-third of them were adult.

Referring to the cod fisheries, Dr. Smith said: And those of our members who are at all interested in cod culture, as practiced on the New England Coast, will perhaps find something suggestive here.

4. Just one moment more, that I may say something about the Norwegian method in regard to our work at Woods' Hole. At Woods' Hole we had a pond, and Mr. Titcomb gave instructions to have this put in shape so that it could be used as a spawning pen. The conditions were entirely unsuitable and unfavorable, but the results are such that we hope to provide more adequate facilities before long.

5. That is all I have to say, and I thank you for your attention. (Great Applause.)

President: Is there any further discussion of Dr. Smith's paper?

Mr. Clark: In the fore part of Dr. Smith's paper, he speaks, I think, something about putting polyps or something of that kind in the bottom of the pond at Christiana. We tried a little experiment this year of spreading manure on the bottom of the pond. Of course, I am not prepared to say very much about this, as the experiment has not been continued. But the pond certainly had more life this spring than it had last, that is sure, more food life for the bass, and our bass in that pond were in excellent shape, and very large—our young bass, and I believe that if something of that kind should be done, spreading manures or something of that kind, on the bottom of the pond, more food could be procured for our spawn fishes.

Mr. Green: I may state that we tried the same experiment at White Plains, not only with manure, but muck. While, of course these experiments have not been extensively carried on, so far we believe muck is better than manure; we can see quite a growth of moss and chara and plants of that kind.

Mr. Clark: I do not think that the manure which we spread increased the vegetation. I think it was a little lighter this year than last, the moss was a little thinner in the pond than last year. I think there is something about manure that produces more life.

President: Any further discussion of Dr. Smith's paper? My recollection is that the Germans followed that method of putting manure in the bottom of ponds for a good while, in raising daphnias, copepodas and things of that sort.

Mr. Lydell: He speaks in that paper, in regard to spreading it around on his pond the following year, and that it is throwing away a very valuable product. We take tons of that stuff out of our ponds and throw it away. According to that paper it is a very valuable thing.

Mr. Clark: It is absolutely necessary to rake and clear it up in order to get our bass fingerlings out, but this year we threw it over—the balance in one pond—we have not started on the other pond—and after it sort of settled down and got in such condition that we could, we spread it out and filled the pond up, instead of throwing it away.

Professor A. D. Mead, Providence, R. I.: I am interested in one other point, the Japanese method of aeration of water. I have been trying to keep alive marine animals of various kinds. My idea is to have the water shallow, rather two inches than two feet. The relative amount of surface to the volume of water, seems to be the important thing, I have been able to keep young lobsters for several months without change of water in a shallow dish with large surface.

Professor Smith: This suggests a change in the shape of our fish transportating cans. It seems to me that for some purposes, our cans are too deep and the fishes at the bottom suffer.

President: I think that is true. But when you are transporting things, you have got to consider motion etc., the amount of water motion that shallow water would get. It is certainly true that you have to keep the water aerated in these cans to keep the fish alive for any time.

Dr. Bean: I happened to see the large collection of gold fish which were brought by a Japanese from Japan to New York early in this month, after a sea journey, as I remarked, of nearly three weeks, and a land journey of about another week, in a very shallow and rather wide Japanese tub. I was surprised when I went down into the laboratory in New York and saw these things and realized what he had accomplished. He had brought eighty percent of his fish from Japan to New York, apparently in good health, and they continued in good health, that is to say, he lost almost none of them after he arrived in New York, although the weather was very warm. Now, he certainly did not have more than three or four inches of water in his tubs. The backs of the fish were out of the water, and as far as I could learn, he did not aerate the water; he had no means of aerating the water on the journey, and told me that he had great difficulty in getting a change of water on the way. It would seem, then, as if there was something in favor of the wide open shallow tub for fish transportation. I do not think it is practical with us, with our great amount of transportation, although he did the same thing, brought them in baggage cars from Seattle to New York in these tubs.

President: There is no question but if we wish to keep fry fish, we put them in a sink and keep them moist. If you keep a little water on them, so that they are kept wet, but not under water, they will live almost indefinitely.

Mr. Carter: Dr. Smith has spoken of the method of handling the cod; of having cod spawn naturally and of drawing the eggs from the surface of the water gradually, I persume that the fish spawn from day to day. With the pike perch, the great trouble seems to me to be that you have to take all the eggs from the fish at the time of stripping, and in reality a small percentage only are ready to be taken. In the waters inhabited by them

these fish deposit a few one day and a few the next. I have seen pike perch spawn in the bottom of our crates. It occurred to me if the crates could be arranged so that the fish could spawn naturally—simply elevate the pen in which the fish are held in some way, introduce the water at one end, at the top, and draw it off gradually from the bottom, let the fish spawn naturally, and collect the eggs from the troughs, that we might get a larger percentage of good eggs than now.

President: You would run onto the practical difficulty of separating the eggs from below, of course, which they avoid in the case of the trout egg.

Mr. Carter: You mean in drawing it from the bottom of the tank. The water would have to be introduced in vats through strainers, of course, clear water. There might be something of that sort. The idea occurred to me; I want to think it over.

SOME PRACTICAL DIFFICULTIES IN THE WAY OF FISH CULTURE

BY TARLETON H. BEAN, STATE FISH CULTURIST OF NEW YORK.

I do not intend to read a paper, but rather to place before you an outline of some of the difficulties which have been met in the fish culture work of New York during the last year and a half, or since about the 10th of January, 1906.

I have not been able to do anything more than make a synopsis of the practical troubles and the menace, which we have, to some extent, overcome; and in some other cases the reverse has been true, we have been overcome by the difficulties. In the first place I noticed here that an excess of air in the water supply has given considerable trouble at two stations. One at Muskellunge station, at Bemis Point, the other at the Catskill hatchery, on the Hudson River. At Bemis Point, Mr. Brown had difficulty in keeping the eggs in jars. He hatches them there in jars now—and also in keeping the fry in the rearing boxes. He did not entirely overcome it at the Catskill station. Now, I must tell you why he did not. In the first place, the water supply at Bemis Point is artesian, the water comes into the hatcheries through a four-inch pipe or six-inch pipe and there was no practical means of meandering it before introducing it in the distributing box in the hatchery. He had to meet the difficulty as best he could. I advised him to meander the water, if he could, but after having done so, I learned that Mr. Charles H. Wallace had adopted another plan; in fact he had two ways of overcoming this excess of air in the water supply. The water supply there was from the city. He put a fine screen in the supply pipe, just a little distance from the receiving box in the hatchery; but the effect of the screen was to remove the bubbles of air, break them up to such an extent that it no longer was able to carry out the eggs from the jars; and I told Mr. Brown about that method, and I know perfectly well that he can't introduce it successfully at Bemis Point in hatching the muskellunge eggs. Mr. Wallace hit upon another plan, which, of course, is a modification of the meandering system, that is to

say, he allowed the water to come into one pond, and pass to another one before it came into the hatchery pipes,—and accomplished exactly the same purpose.

We have had a great deal of trouble on the score of dry weather at some of the trout stations, and I need not go into the details about that with you.

Excess heat has also caused considerable difficulty, particularly in trout streams which are very rocky. The intensely hot air has caused the rocks to warm up, and to retain the heat, and thereby communicate it to the surrounding water to such an extent that a great many trout have been killed, simply by the excessive heat.

Another practical trouble which affected the shad work during the past season must have been observed by all who have been engaged in that work, and that was the very low temperature of the water early in the season and continuing until say, up to the 1st of June.

At one of our stations, we have another practical difficulty in the shape of a grist mill, which stirs up and uses most of the water supply of a good trout brook, during about one-half of each day, so that we can get at most only about a ten inch pipe flow of water during the dry season of the summer, when the mill is in operation. We do not know at present any good way to get rid of that difficulty, except that we have another string to our bow; fortunately there is on the other side of that station and alongside of our own property a very much larger creek, a creek about 50 feet wide and over forty miles long, which has a succession of rapids in which we could easily, by means of a dam, get a new supply. We could get one from that stream which would flood two hundred acres of ponds, if we had that amount.

President: Couldn't you get the state of New York to buy the mill?

Mr. Bean: The owner of that mill is a man who has considerable property, and would not sell at any price? It could be condemned. In fact, that leads me to another heading—the scarcity of good hatchery sites. It is perfectly astonishing, even to the practical fish culturists, to note the very great number of

places in any state—we will say almost any state—which look good at the outset for trout culture—especially for trout culture—but which turn out to be deficient, because there isn't water enough; and in some cases too much of the water is used for industrial purposes. That is true in New York, and in order to complicate matters still more all over the country, this natural scarcity of good hatchery sites is supplemented by a natural desire on the part of certain individuals to force the location of a hatchery into some site known to be unsuitable for fish culture purposes but quite suitable for booming real estate. This is a practical difficulty which we cannot pass over lightly.

In the transportation of fish in New York, there has been a great deal of trouble through defective car service. The state has only one car—and I presume this will apply to other states besides New York—the state has one car, which is not a modern car by any means, that is to say, it will simply carry fish in cans, and has an ice box—has no means of circulating the water, or of regulating the temperature. And such car, while it has its uses, of course,—is not to be despised by any means—is a little bit too inadequate, it seems to me, for any great state to use at the present time.

Then there has been considerable difficulty of late in securing railroad transportation. This is not a general difficulty, but we fear it is going to become general, through the opposition to railroad management at present. We fear at least it will become more serious than it has been so far.

The losses of eggs in transportation sometimes have been rather large and almost unaccountable, as well as the losses of fish; and in some cases we have found we would be able to trace the losses of eggs to defects either in the system of packing or in the kind of material used in the egg cases. Very often we know that moss has been used which is not thoroughly washed and prepared for the journey, and this moss, as you all know, in some instances, carries bacteria which introduce disease into a stream. We have had such cases within the last year and a half, and we have to watch the matter very closely on that account. In other words, we have to be very careful from whom we buy goods and crates, and insist upon it that they shall be properly

packed, not only in regard to the methods of packing, but the material used for the transportation of the eggs.

Improper food has caused a good deal of loss. Impure food has been even a more active cause of loss of fish—and by impure food, I mean liver, for instance, which has been practically spoiled or soured in some way. You may say that these things can all be avoided, which is very true, and I hope they will be, in the course of time. Accidents will happen in the very best of families, and where food may be obtained one day, where service has been reliable up to a certain point, and you find something has been sent which is not up to the standard, but which you must use for want of something better—you will see that the complication is not an easy one.

Pollutions of the waters of various kinds, from the acids proceeding from wood alcohol factories and the sawdust from saw mills, have continued to give us more or less trouble.

Another very practical difficulty arose near Tivoli, during the present shad season. We were counting upon a late take of shad eggs near Tivoli, in a little channel, but when the men got in there they found that someone had dumped cinders to such an extent that the shad had deserted the channel, and they could not pull the nets through it.

We had another case near one of the stations. The owner of some stock, horses and sheep, allowed dead animals to be placed in one of the streams, which we were expecting to use, and we had a great deal of trouble with that man, and we finally had to apply even to the state health board, before we could compel him to take his dead horses and sheep out of that stream.

There have been great difficulties in collecting eggs. Last fall, bad weather interfered very greatly indeed with egg collection, especially on some of the great lakes. We lost several cases of whitefish eggs at one time through nobody's fault, but just because the weather was so stormy that it was impossible to save them. We have even had violence offered, in some cases, to the men who were engaged in taking eggs. On Long Island, a man was assaulted while in the act of collecting smelt eggs near Center Port. This does not often happen, though it has happened to us in Canandaigua, and I have been told by one of the members that when his father first began the work of shad hatching

he was obliged to lie on the bank near the box until the shad hatched, with a pistol in his hand, to protect it.

Another difficulty in our egg collection has been either an excess or scarcity of male fish at the proper time, and still another has been the unexpected movement of certain fish as, for instance, the smelt. The habits of the smelt have become pretty well known, on Long Island especially, where we take something like a hundred millions early in the spring; and yet, the men best acquainted with the habits of the smelt have been at a loss sometimes to know where to find the fish. Usually they run up into the little creeks, not far from salt water, and deposit their eggs in the sand and gravel; but occasionally they will forsake a stream which has been a favorite spawning ground for them, for some unknown reason, and then they must be sought for; and it is not very easy work to hunt for smelt at night, because they spawn only at night, and leave the streams just at the break of day.

We have had also a great deal of trouble because of the lack of information about the results of work. Every fish culturist wants to know whether his work is successful or not, and in our state we try through the officers of the rod and gun clubs and the fish and game leagues, to discover whether or not we succeed in establishing a species in given bodies of water.

Just to illustrate how hard it is to obtain satisfactory information, I will tell you an experience, without mentioning any names. A lake in western New York was stocked with pike perch, at the request of a certain rod and gun club. The president of that club, a man of considerable intelligence, and supposed to be well acquainted with common fish at least, informed the boys that they were taking large numbers of young pike perch in one body of water which he had stocked and in which he was especially interested. He was asked to send a specimen, which he said he would do; he was told how to preserve it, and preserved it. It came to the desk of the fish culturist, and when the package was opened it was found to be a sunfish. So that we do not know now whether we have succeeded in establishing the pike perch in that lake or not.

Another illustration of the same difficulty occurred in the central portion of New York. It was said that young pike perch

were running up a certain creek in the spring in enormous shoals, and that they were being attacked with a peculiar eye disease, and losing their eyes. Of course that called out the fish culturist, and to his utter astonishment, he found that the information, which had come from one of the best fishermen in the state, and one of the best fish culturists in the state, too, was entirely erroneous. The fish were not pike perch at all, but trout perch, the little *percopsis guttatus,* which you know so well, and every bit of information which had come to the office about the big pike perch eating the little pike perch, and the big fish coming in, and the eye disease, related to this trout perch. We did discover afterwards that the yellow perch and the pike perch had been attacked by this same disease, and we don't know now, what this disease is which carried away, I am safe in saying, tens of thousands of fish measuring from three to four inches. We know absolutely nothing about it, except what Dr. Marsh of the Fisheries' Bureau could tell us, which was very little. He has not been able to isolate the bacillus and could only do so through field work. He has not been able to do the field work, and the disease is now in progress; it is very fatal. I have that as one of my captions here. The little fish run up the creeks at Constantia from Lake Oneida, beginning in the month of May and continuing through the summer. In two or three days after their appearance in the small creeks, it will be noticed that one of the eyes, or perhaps both of the eyes, is inflamed and intensely red. A few days later it will be seen that the eye has been removed entirely from the skull. Now this is not popeye. I know popeye as well as I know a piece of bread when I see it; it is not popeye. As Mr. Marsh says, it is an entirely new disease, of bacterial origin. Sometimes both eyes are destroyed in this way in a very few days; and this will happen to bass, yellow perch and any other small fish that may be in the creeks at that time. It is a very fatal disease.

President: How long does it last?

Dr. Bean: Lasts all summer. It is well worth attention.

Gentlemen, I do not intend to read any more of this paper, because you will see it in much better form later on, but I would like to mention the other points. This lack of information about

the results of stocking is supplemented by the further lack of information about the natural food of the regions to be stocked, and that, of course, is an old story. Also, about the kind of fish that inhabit the waters, we want to stock.

We have had a great deal of difficulty from illegal fishing, that is to say, illegal netting, which deprives us, we are sure, of a great many male fish in Canandaigua, Placid, and some other inland lakes. Generally the whitefish netters get in their work before we get on the field, and they take the males, because the males run first, and in that way, we have been unable to get sufficient milt. Hundreds and hundreds of ripe females have been lost for want of milt.

Of course there have been fish parasites, especially the common parasite, which you all know as the gill louse parasite, which has affected the brooktrout in the Adirondacks and by unfortunate chance has been introduced into other waters, by the bringing of adult fish from the Adirondacks into other waters. You may say, of course, that the messenger should know better than to transport fish afflicted with gill infection, but we are dealing with a fact and not a theory. As you know, the parasite becomes firmly attached to the gills of brook trout, and whenever it has become attached in sufficient numbers it invariably kills the fish when they are two or three years old. It does not attack young fish at all. Now the only remedy that has been suggested for this parasite is one that has to deal with the young form of the parasite, that is the swimming larvae. The remedy is a different swimming fish, say for instance like the fresh water killifish, or the top swimmer, any little fish that will swim at the surface, such as the sheep's head killifish or any fish of that kind which will live in the cold trout waters will answer the purpose of feeding on the swimming larvae so that there will not be enough to kill any fish, and thereby the disease is kept in check.

Fish diseases. We have had a number of very fatal diseases to overcome, and we have been able, fortunately, to handle some of them. One is the well known ulcer disease or furunculosis of the brown trout, which prevailed to such an extent at one of our stations as to carry off all the brood stock. That has been en-

tirely overcome at that station by a total change of the water supply. In no other way could we do it, because we did not control the entire stream. You know what it is, of course. Boils break out all over the surface of the body. The disease is of bacterial origin, and originates in streams which have become polluted, especially by the washings from manure heaps, barnyard manure, and even from other sources, water closets etc., draining into the stream, bringing on these conditions on which the bacteria thrive. But we have now cut out that stream entirely, and by the introduction of spring water, we are able to raise brown trout just as well at the station as we ever were. Fortunately the rainbow trout is immune to this disease, and in order to deal with it on Long Island, we are introducing rainbow trout to replace the brown trout as far as possible.

I have still several other points, but the time is passing and I will not enter into them at present. I thank you gentlemen for your attention. (Applause.)

DISCUSSION.

Mr. A. Kelly Evans: Might I ask Dr. Bean if he knows of the success attending the efforts of, I think, the Rogers' process, in looking after the harmful waste in the pulp mills?

Dr. Bean: Mr. Chairman, I have not been able to give that matter any attention at all, for two reasons. In the first place, that whole subject of pollution is in the hands of the chief fish and game protector, Mr. Burnham, who has gone into it very thoroughly indeed, and has compiled an immense amount of information on that subject, and has instituted a number of suits against mills and factories which are polluting the water. I do not know what the Rogers' system is at all. I know what some of the foreign countries do in the way of utilization of sewage and rendering waste harmless, but I do not know anything about that system.

Mr. Evans: The reason I asked is that we in Ontario and Quebec are face to face with a very serious problem, the export or non-export of pulp. The provinces of Ontario and Quebec possess a great majority of the pulp forests of the continent now, and undoubtedly in a very short time a great number of pulp

concerns and paper mills will go up in Ontario. Well, you can easily understand how difficult it will be to attempt to interfere with such a large and important industry as this, and, therefore, I hope that efforts I understand are being made in the United States will meet with success. I was very anxious to know how it stood at the present time. I understood from the Bureau of Fish and Game that this new process had been tried in experimental form to handle a portion of the waste, and had been successful.

Dr. Bean: I do not know, but I advise you to write to Mr. Burnham on that subject. He has spent a lot of time on it. I have been so busy with the protection of fish that it has been impossible for me to give any attention to that subject.

THE NECESSITY OF THE PROTECTION OF THE ADULT LOBSTER, IN ORDER TO MAINTAIN THE LOBSTER FISHERIES

BY G. W. FIELD,

Chairman Massachusetts State Fish Commission, Boston, Mass.

Mr. President and Gentlemen of the American Fisheries Society:—

The main feature to which I wish to call your attention is, the necessity of the protection of the adults, if we are to carry on the experiments and the work undertaken by Dr. Mead, and by the United States Bureau of Fisheries. It is too obvious to necessitate the calling of further attention to the fact, that if we want to raise young animals, we must have the eggs. Now the observations which we have made,—and I think they are confirmed elsewhere, both in the United States and in the British provinces,—demonstrate the fact that the decline of the lobster in point of numbers and in point of size is an actual fact; and I do not think I need to dwell upon that side of it. So that, when we come to consider the matter, we are actually face to face, not alone with a condition, but with a condition and a theory. That condition, as I have said, is the actual decline of the lobster fishery. That decline is most obvious in the neighborhood of the great markets of New York and of Boston, and possibly some points in Maine. In most sections of Maine, and in parts of Nova Scotia, that decline is marked by the fact that development of power-boats and of apparatus has gone on to such an extent that the market is apparently well supplied with lobster. But, on the other hand, greater efforts and wider territories must be covered in order to meet the market demand.

I have here some figures taken from the Massachusetts report, and I may say that those are based upon the sworn statements of the lobster fishermen, backed up somewhat by observations of persons interested in the industry. In 1890 (I select those figures because our figures before that time were more or less incomplete) in Massachusetts there were at work, 379 fishermen, and in 1906, there were at work 335 fishermen. In 1890,

there were 19,554 traps; and in 1906, 21,918 traps, an increase of more than 2,000 traps by about fifty less fishermen. The catch of lobsters in 1890 was 1,612,000; in 1906, it had fallen to 487,000. Correspondingly in 1890, the number of egg lobsters taken was 70,909; in 1906, that number had dropped to 9378 lobsters. In 1890 there was one egg lobster to every 22 captured; in 1906, there was one egg lobster to every 52 captured.

Now, it seems to me that that cannot mean anything else than a tremendous decline in the actual reproduction of the lobster. In other words, by destroying the largest lobsters, we have reduced the productive capacity of the rest to that extent, viz: in the ratio of 52 to 22.

Now, in a similar way,—and I do not care to put too much stress upon this aspect of it, although I cannot put too much on the actual decline which I have indicated, as to the ratio between the egg-bearing lobsters and the non-egg-bearing lobsters—the catch per pot in 1890 was 82, whereas in 1906, it had shrunk to 28 on the average. Now, of course, it might be said that more pots would naturally mean a decrease in the number, so that there might possibly be some misconception in regard to that; but it is an actual condition that in order to maintain the catch, you have got to put out more pots.

Now, our fishing area in Massachusetts is somewhat limited. We have not a great range of seacoast, nor the peculiarly favorable conditions that maintain in Nova Scotia. On the other hand, the fishing is peculiar in the fact that on the Massachusetts coast, we get a definite migration. They come into the harbors in July in very large numbers to shed. On the 13th day of July, there was a very marked immigration in the Boston harbor, particularly of lobsters, apparently coming in there for the purpose of shedding; they lie up there in the soft mud.

Now, the most important question, it seems to me, is, what is the cause of this decline? I have a little diagram here, unfortunately scarcely large enough to be seen all over the room—based upon our observations during the past two years, upon approximately 6,000 egg-bearing lobsters to a pot, and carefully measured—59,933 is the exact number. On this end of the line, we have the number of lobsters which were found with eggs. The smallest one we found was seven and three-quarters

inches, and below nine inches, or between eight and nine, there were but two lobsters. Between nine and ten inches, there were 117 egg-bearing lobsters; between ten and eleven inches, 1017; between eleven and twelve inches, 1749; between twelve and thirteen inches, 1902; between thirten and fourteen inches, 896; between fourteen and fifteen inches, 208; between fifteen and sixteen inches, 52; between sixteen and seventeen inches, 39.

Now, to indicate the reproductive capacity of these individuals, or rather the number of individuals represented in this, we find that the great height—the greatest number of lobsters which we find, are those between eleven and thirteen inches, or between twelve and thirteen inches is the maximum reproductive capacity. We find more lobsters bearing eggs between twelve and thirteen inches than at any other point. After that the decline, under present conditions, is rather rapid. There is, however, possibly some reason to believe that before we caught such a tremendous number of the large lobsters, this curve was somewhat different from this, and there was probably, a more steady decline, as indicated by results on certain other animals. The reproductive capacity should not drop down so rapidly.

There is no doubt that the lobster lives to a green old age. We do not know exactly how old that is, but the steam trawler, or auto-trawler is catching a very considerable number of lobsters during the past two years, which are so large that they cannot get into the present pots. The pots generally have a funnel of five or six inches, and these lobsters have a diameter of seven to eight or even more inches, and those lobsters could not get into the pot; and it is only within the past one or two years that we have found them in great numbers; they were occasionally caught on trawlers, but they are recently being caught in large numbers.

President: How much do they run in pounds?

Mr. Field: They run twenty-three pounds. Under our present laws they catch the lobsters either above eight inches in Nova Scotia, or above nine inches in New York and Rhode Island, and through other parts of Nova Scotia and at present about nine inches in Massachusetts, and above ten inches in all the other states. Now, look for a moment and see what the

result would be on the number of eggs laid if all the lobsters above ten and a half inches were to be caught, and see the further effect if all the lobsters above nine inches were to be wiped out. You would wipe out at one stroke the entire reproductive capacity of the race. Now, the only saving thing in the present lobster law, is the fact that we do not catch all the lobsters, and a certain number of these are left to reproduce. But without question it would be far better for the lobster if all these lobsters above this age were to be preserved for breeding purposes. Perhaps I ought to say in addition, that, as offsets to this destructiveness, are the first efforts to maintain and buy from fishermen, the egg-bearing lobsters. That takes care, of course, of an additional number. By using our best efforts, we have succeeded in buying, during the last two years, about 6,000 lobsters. On those, approximately 1000 or 1500 have been sent to Woods' Hole; a similar number have been sent to Gloucester; the balance has been taken out to sea five or ten miles, and liberated. We have punched holes in the tails of those 6000 lobsters, by means of an ordinary harness punch, and in that time we have bought 77, if I remember correctly, (less than 80) of those lobsters the second time, and we have bought less than five, three times. Mind you, those lobsters are taken out as green egg lobsters, or chiefly green egg lobsters, in the month of July, ten miles off shore, and there liberated; and only that relatively small number have come back and have been caught within a year, or within practically ten months.

Now another most important factor in maintaining the lobsters has been the fact that the United States' bureau of fisheries, have been far-sighted enough and have carried out with admirable success, the utilization of those eggs, which otherwise would have been destroyed by the fishermen. They have bought those eggs from the fishermen, and have hatched out many millions of eggs and delivered them in the water,—eggs which otherwise would have been destroyed by the fishermen. The eggs are certainly destroyed at the present time by fishermen in certain sections, sections so remote that they are not at the present time reached by collectors. I have in mind particularly the extreme end of Cape Cod; where a large number of fishermen go and take a whiskbroom or brush, and brush the eggs from the lob-

sters. We are absolutely certain that that is done, but at the present time, we can do nothing to stop it. We hope to do so in the immediate future.

The other efforts made, have been on the line of adopting a close season. Now, while a close season may be effective in the case of certain rapid-breeding animals, many birds, and possibly some fishes, it is very questionable whether it meets the results expected in the case of lobsters, which are remarkably slow breeders, reaching sexual maturity only after four to seven years, and after that, breeding but once in two years and carrying the eggs after they are ready, at least ten months attached to the external legs, and requiring practically another eight or ten months to prepare ovarian eggs, before they are ready; so that practically the female lobster lays but one litter of eggs every two years, although there may be individuals which lay more frequently. A close season further is subject to the criticism that it restricts the demand during a certain definite season, but does not increase the supply. It makes absolutely no difference to the future of the lobster whether those eggs are destroyed at the time they are laid, within a month after they are laid, or a month before they are hatched. So, in order to have a close season, you have got to have a close season extending over at least ten months. And ordinarily the close season is placed upon the lobster during the time when they are of use as food or during the time when they do not pot in such large numbers, because of the fact that they are migrating to the shore in order to shed. So that the ordinary close season from the first of June or the first of July to the first of September seems to me little adapted to meet conditions.

Now, we have brought forward the suggestion, based upon a biological principle, that in all our domesticated animals, we save the breeders, or at least a sufficient number of the breeders to meet the market demand for the young, and use the young for food. So the suggestion is made that we use only the lobsters, for example between nine and eleven inches, during the period when they are of least value for reproductive purposes, and at the same time of very considerable market value, and then save those above eleven inches at the very crest of their reproductive capacity, for reproductive purposes. Up to the pres-

ent time it has been very difficult to secure such a uniform law throughout all the states, for the reason, first, that the fishermen are notoriously selfish in the matter, and openly say, "As soon as the lobster is gone, we will simply turn to something else; we want all there is in the lobster business at the present time, and never mind the future." The lobster dealers have organized on the basis of using the large lobsters, and all their mechanism is adapted for present methods, and they look askance on any change. The present is all right for them, and they are not worrying about the future. With the development of transportation facilities, they are getting all the lobsters they care to sell, and they are able now, to practically handle the market as they think best.

Relative to the enforcement of such a law, it has on its face the very difficult proposition of a size limit on one side and a size limit on the other, so that opponents say, if it is difficult now to enforce the law above or below ten and one-half inches, it will be twice as hard to enforce it with a double size measure. To obviate that we have made some experiments, in which we found that a trap with a ring nine and one-quarter inches inside diameter, will shut out practically all the eleven inch lobsters, and will absolutely or practically prevent the catching of the largest lobsters, those that are most valuable for reproductive purposes; and the plan is to have those pots examined and marked and sealed, and it will be illegal to have pots in the possession of fishermen, or others different from those specified. Every pot which is made, must conform to the legal specifications, and if they do not, they can be destroyed on the spot by the inspector. That makes it much more easy to inspect the pots, that is, to inspect the lobsters; they will handle the lobster automatically.

Now, it seems to me that such a law, particularly if it is a uniform law throughout the states and provinces, would be of great value to the lobster, owing to the fact that it would permit the very best individuals to breed. At present a large portion of our eggs are taken from immature individuals. We practically put a premium upon the taking and destruction of the very best breeders, and anyone who is engaged in breeding stock, will

know how suicidal that is. It is absolutely necessary to progress to breed from the very best animals.

Further it would give every fisherman an equal chance with every other fisherman. There will be no question as to what lobsters shall be thrown overboard, or whether one man is honest and throws his lobsters overboard, to be caught by his neighbor, who is not in the habit of throwing lobsters overboard.

But, most important of all, it seems to me, it applies the biological principle of the protection of the adults to the lobster, to an animal, which, up to the present time, has never been subjected to that principle of action.

Apart from its novelty, from the fact that it practically is a reversal of the present law, certain other objections have been made to it. First, it has been said, that if you catch all the short lobsters, all the small lobsters, how will there be any large lobsters? Of course that is simply an argument in a circle. Correspondingly, if you catch all the large lobsters, there will be no small lobsters coming up. So that argument has its value only in the question as to how many of the short lobsters would be taken under these conditions.

Over against that should be placed the fact, that whereas, under the present law, we allow the catching of lobsters throughout their entire life, under this suggested law, you are restricting the catching of lobsters to practically one, or at least two molts in the lobster's life, and you know the lobster increases upwards of fifteen percent at each molt. That means that a ten inch lobster in a month would pass over into the exempt class, become practically an eleven or eleven and a half inch lobster. So that the time during which those lobsters would be subject to catch is very much diminished by a law such as is proposed.

In addition to that, there are various opinions, particularly among the fishermen, as to the size, some calling for an eight inch lower limit, and others for a twelve inch upper limit, and so on. That is a question of practical expediency, which could be settled later, but for the sake of argument, we have settled upon this matter of nine to eleven as the best size to be recommended.

That, in general, is an outline of what we have had in mind. I am very glad indeed to talk the matter over further, or answer

any questions I might. I have covered the subject, I realize, very unsatisfactorily. We have discussed it at greater length in a pamphlet, which I would be glad to furnish to anyone who cares for it.

I thank you. (Great applause.)

DISCUSSION.

Professor Mead: I would like to ask Dr. Field one question about the curve. The curve, as I understand, is made up of the number of the egg lobsters.

Mr. Field: Yes.

Professor Mead: Does it show what the proportion of egg lobsters, to all lobsters is, at any particular period of life?

Mr. Field: No, it is made in this way: For example, we found 1749 lobsters of a size between 11 and 12 inches.

Professor Mead: How many lobsters are there in all in that period?

Mr. Field: These are all egg lobsters, every one.

Professor Mead: How many lobsters are there of that same length that are not egg lobsters? Does the curve in your diagram show the proportion of egg lobsters to all the lobsters?

Mr. Field: No, not at all. The only figures we have on that are those which I quoted, in which we found that at the present time, there was one egg lobster to every 52 in the Massachusetts catch; but we know nothing about the relative size of the other individuals. We do know that there is one egg lobster to every 52, above 10½ inches, that is as near as we can get to it from the figures in our possession.

Professor Mead: I had supposed that curve indicated why you picked out that particular period—because of the greater fecundity of lobsters.

Mr. Field: No.

Professor Mead: Why wouldn't it be a good plan if you are going to take a curve and pick out the 10½ to 11 inch period, to take out those big lobsters, which do not lay any eggs.

Mr. Field: Yes, they do lay more eggs. This is the number, but this does not represent the value of the eggs. These larger lobsters, of 15 and 16 inches will lay in the neighborhood of 60,000 to 80,000 eggs, whereas these down here (indicating) would lay only about 5,000 to 10,000, these practically on this side of the line not over 20,000, whereas these on this side lay from 20,000 to 80,000 or 90,000 eggs.

Professor Mead: On the other hand, those lobsters, if they are allowed to live, as indicated, on the first side of the line of your diagram, will produce for several seasons, while those on the other side are rapidly declining.

Mr. Field: It is a question whether they are rapidly declining.

Professor Mead: Although they are worth two or three times as much for food.

Mr. Field: We found in our observations that there are about six times as many lobsters between 9 and 11 inches as there are those above that,—at least that,—we don't know but more in certain places. Let a man go out in a boat, and measure every lobster that came into the pot in order to get an idea of the number of lobsters of that particular capacity.

President: Your idea would be to exempt those between 11 and 14 inches.

Professor Mead: I have not made that as a definite proposition, but I do not see why according to the curve he has got there, you should not exempt the larger ones.

Mr. Field: The thing you have in mind is represented by one curve, and this represents another thing. This curve does not show the capacity.

Professor Mead: That would not represent the truth, because your absolute capacity depends both upon the number and the number of eggs per individual.

Mr. Field: That is true.

Professor Mead: But it does seem to me, if you kill off the

comparatively young lobsters, you are throwing great stress upon very valuable breeders. If you take out the 9 to 11 inch lobsters, you are taking out those which can breed now, and those which would breed again and again if you left them alone, and of course, you are throwing additional stress upon that limited period, by exempting the other lobsters, among which are the very large lobsters which are rapidly declined in their breeding capacity.

Mr. Field: It is a question whether they are rapidly declining. There was no question according to various observations that they increase up to 17 inches, and after that, we do not know anything about them. At 16 inches you have 19,000 eggs.

Professor Mead: You had only 19,000, that was less.

Mr. Field: We do not know how rapidly the decline is. The chances are the decline is about the same as the increasing curve.

President: Any further discussion of the paper?

Mr. Field: I ought to say, that perhaps Dr. Mead overlooks the fact or assumes that a tremendous number would be destroyed, and that is doubtless true; at the same time there would be a large number which would get by, for the reason there is a relatively short period in their lives where they are exposed to capture, whereas, at the present time, they are exposed to capture throughout their entire life.

Professor Mead: I am interested in this subject, and have talked with Dr. Field a great many times, and we have always failed to agree as to the effect of protecting the young or old, just as some people present have failed to agree on the general principle of "Fry vs. Fingerlings." Just now he brought up the objection to his theory, which presents itself to everyone, that by allowing the old lobsters to be exempt, great stress is brought upon the young. He said, in explanation of his curve, that it would be a terrible thing if all of the old egg-bearing lobsters were wiped out. Of course, it is equally true that if all the young ones were wiped out, it would be unfortunate. It seems to me there is one thing that ought not to be overlooked,

that is, throwing the stress on the young lobsters with which the fishermen must fill the market demand. This will take a good many more lobsters than if they are allowed to capture the old ones. I know perfectly well this argument is a plausible one; but it seems to me the case here is a little different from that of domesticated animals, like chickens, where within a year or two, the weight of the young is quite as great as that of the old. But take the 9 inch lobster, and you have got to sacrifice a good many to make up for one old lobster, and moreover, the old lobsters, when they have reached a certain size, are good for nothing. The proposition as modified by Dr. Field, of allowing simply the lobsters between 9 and 11 inches to be caught is quite a different proposition from allowing those below 9 inches to be caught. I admit that I have wondered, however, how this would work out practically among the fishermen, in whom human nature is strong,—our Greek and Portuguese and other fishermen along the Atlantic Coast. They are very unwilling now to allow the egg lobsters to get by, or to allow the young lobsters to get by. It seems to me there would be much difficulty in persuading them that they ought to allow the old lobsters to go by. It takes a good deal of nerve to throw over a good three or four pound lobster on general principles. That, of course, is a practical point. I have often wondered too whether the general principle would be admitted, of taking the young and leaving the old, by the practical fish culturist; whether if he had a lake full of trout, he would be willing to pick out each year all of the young trout and leave the old ones.

I think it is very important, and of course a good many have also put out the same opinion, that we should have along the Atlantic Coast from Maine to New York uniform laws. Dr. Field himself has taken steps towards bringing about such a result.

I think that is important, for it has been shown that the difference in the law for example, between Massachusetts and Rhode Island, was very detrimental to Massachusetts. When the people right on the line between Rhode Island and Massachusetts can take 9 to 10½ inch lobsters and bring them over into Newport and sell them, it is very natural that they should do it. You cannot catch them, because they put the shorts in

the well, and kick the bottom out, if they see the police coming. Newport has been loaded up with lobsters from Massachusetts. We thought some time ago of increasing the limit in Rhode Island to a little larger than it is in Connecticut. But it seemed to me the same trouble would occur there, and Rhode Island fishermen would take their lobsters over into Connecticut.

With respect to the biological aspect of the question at issue I have taken the view that what we need is protection for the very small lobsters and not merely or perhaps not mainly an increase in the number of eggs. Of course every one knows that if the lobster on the average produces 10,000 eggs, 9,999 of them do not reach maturity on the average, otherwise the sea would be filled with lobsters in a very short time. There is an overproduction among animals as a rule, and it is counteracted by corresponding destruction of the immature. There are therefore two opposite ways by which a species in nature maintain their abundance; one by producing enormous numbers of young without much provision for protection, as is the case with the shad, lobster and scallop, the other by producing small numbers of young and providing special protection for them, as in case of the dogfish, skate, toad-fish and the abundant species *Crepidula* among mollusks.

In dealing with a species like the lobster where the number of young and the infant mortality are great, it looks to me as though we can do more good by following the first named method, that of protecting the young, than by endeavoring to produce greater quantities of young to be a sacrifice. Now, there is no question at all, I think, that the usual destruction of lobster fry, immediately after the eggs are hatched, is perfectly enormous, and then is lessened step by step as the lobster grows older. There is no doubt that fingerling lobsters too, are destroyed in considerable numbers, by cat and dogfish. But as they increase in size the destruction is proportionately less. Of course, that might be applied in different ways, but to my mind it shows that the lobsters that have gone through a period up to when they can begin to breed are very valuable lobsters, and they ought not then to be killed off before they have a chance to breed. I know that the original proposition of Dr. Field's appeals strongly to a great many people at first glance; it is a very plausible

theory, and so much like the old academic question of the hen and the egg—which comes from which, that it is very puzzling. One thinks one way one day and another way another. The practical side must have a very strong influence in deciding what the legislature shall do about it. I think it can hardly be treated entirely as an academic problem, partly because, although Dr. Field has very many interesting statistics—we have not sufficient information in regard to the proportion of the large egg lobsters to all of the egg lobsters, and many other questions of that kind.

Dr. Field: I would say, Mr. President, that one important question which we have in our department is the enforcement of the law, and there is no law more difficult to enforce than the present lobster law, whether it be 9 inches or 10½ inches, so that the suggestion made that the law be transferred to the pot instead of the lobster, is going to be a great step in advance in dealing with the Greek and Portuguese fishermen, of whom Dr. Mead speaks and with whom I am very familiar. It is perfectly feasible to examine the pots, and to pull up the pots and measure them, and see that they have been inspected, where it is absolutely impossible to chase a man, and get the short lobsters in his possession.

Now, in regard to the practical aspect of this, and the effect upon the market of a change in the law, we have been in the market and measured some of the local lobsters and Nova Scotia lobsters exactly as they are found in the Boston market today, and we have compared those with the number that we have to use in order to get exactly the same weight of lobsters if they allowed the taking only of those between nine and ten inches, and we find they have to handle 155 to every 100 at the present time. That would practically be an increase of 55 lobsters in every 100 instead of the killing of a large number of lobsters as Dr. Mead has suggested might be possible.

We ought to say, of course, that we are pleased with the work of Dr. Mead and of the Rhode Island commission and of the United States bureau of fisheries, and very sorry indeed to see them placed in the position of the man who did not take his medicine, so that he was never able to tell what it was that cured him. In short, while we believe that the short lobsters ought to

be protected until they reach the market size of approximately 9 inches, we believe that the market ought to be allowed to have certain lobsters, which would be placed upon the market with the least harm, and that, it seems to us, is between 9 and 11 inches, before they have reached the highest period of maturity, and when they have reached a size where they are of considerable commercial importance.

President: Speaking from the standpoint of a state whose lobsters are all of the crawfish variety, I do not believe that this proposition can be solved except by trying it; that the arguments both ways are pretty good and that Massachusetts better try and see whether the lobsters will increase on it.

THE INFLUENCE OF POLITICS UPON THE WORK OF THE FISH CULTURIST, AND HOW FISH AND GAME PROTECTIVE ASSOCIATIONS MAY ASSIST THE LATTER

And

THE INTERNATIONAL PROBLEM OF THE PROPER REGULATION OF THE FISHERIES OF THE GREAT LAKES

BY A. KELLY EVANS, OF TORONTO, CANADA.

Mr. A. Kelly Evans: Mr. President and gentlemen, it is with a great deal of trepidation indeed that I venture to make a few remarks, considering that the gentlemen may be considered savants on the question of fish culture, but as I shall not be long, I trust you will bear with me. I want to give you an idea of what might be deemed the necessity of taking an interest in organizations which may help you largely in the work you are carrying out. I refer to fish and game protective associations and organizations of that kind; and in order to make my argument clearer, I wish to explain certain things that have occurred in our province of Ontario.

I feel you must all take an interest in the province of Ontario, particularly because it controls practically one half of the fisheries of the Great Lakes. Besides this, it has enormous resources in other lakes which do not touch your borders, besides very large rivers. There have been two commissions appointed of late years in Canada, one by the provincial government at Toronto, a liberal administration, and one by a conservative administration at Ottawa. This document is a very rare one. It contains such an expose of the horrible destruction that has been going on, that it has been more or less suppressed; but I am fortunate enough to possess a copy, and I will simply read one little bit of sworn testimony to show you the condition existing in Lake Ontario comparatively a small number of years ago; you are quite aware of the condition existing now.

This commission was appointed by the late Sir Hibbard Tupper, in 1893. The commissioners proceeded all through the

country, and the evidence was taken in large quantities, under oath, in a most exhaustive way. The evidence of this man which I am going to quote, I chose partly because he was an American citizen, afterwards becoming naturalized in our country. This evidence was under oath.

Mr. Robert Hutchins, was duly sworn. Lives in Midland. Has been a fisherman since 1850. Is a British subject since then, though born in the United States. Has fished here and in Georgian Bay for fourteen years. Balance of the time in Lake Ontario.

"I have fished in Lake Ontario about thirty years for whitefish and trout, the great majority was whitefish, and caught at Wellington Beach; they were caught very numerously with seines; as many as from five thousand to ten thousand in one haul during a night; this was in the summer time, in June and July, and these were salted or sold on the ground, to dealers. I have caught as many in a season as would allow the owners of the seine for their share about $2,000.00, the other $2,000.00 would go to the fishermen; even more than this number were caught sometimes. Fishing was carried on in the fall of the year also. Whitefish were thick also everywhere in Lake Ontario at that time. I have known as many as 90,000 to be taken in one haul in one night; I was present and saw them counted. I have often known of from 5,000 to 10,000 being taken, and have taken 40,000 myself in a seine several times. This was in July, at Wellington Beach. Those that were saved of the 90,000 haul were salted; many of these were lost because they could not be taken care of. There was another haul as large as this taken at West Lake Beach; the net was a one hundred and seventy-five rod seine and it was then called, 'the sou-wester'. When I left Lake Ontario some fourteen years ago, there were no whitefish to be had by the fishermen where these great hauls had been made before, in fact the whitefish fishery had ceased to exist, there was no more of it. I left Lake Ontario to fish here, and a number of other fishermen also left there for the same cause."

You know of the horrible destruction that took place about the time that he is speaking of, here in the Detroit River, where on the Canadian side we had pens constructed and where immense destruction was caused to the fish.

Now it is unnecessary to tell you that in this report, the recommendations of the commissioner were very sweeping. This report of the Ontario government was obtained something in the same way, except, that in reference to the fisheries, they sent out written questions which were answered by 497 persons of all descriptions, and besides that they took sworn testimony at many points throughout the province. The only points that I will draw to your attention are some of the recommendations of these commissioners.

"Your commissioners are of the opinion that pound nets should be entirely abolished in the waters of the province. The extent to which netting is carried on is also inconceivable, and the spawning grounds are stripped year after year until in many places where fish abounded formerly in large numbers, there is no yield now at all. If a force of game wardens was appointed, this matter could be vigorously looked into and the slaughter and destruction could be very considerably lessened. The value of the fish yield is enormous, and too much pains can not be taken to preserve what should be always a cheap food supply for the masses."

And so on, through their report, it is a damning arraignment of the existing condition of things.

Now, gentlemen, it is inconceivable to believe that any statesman wishes to do harm to his country, and when I tell you that those two documents, prepared at great expenditure of time and money of the people, undertaken by scientists and men who are quite qualified in taking evidence and making the examination and recommendations, are practically a dead letter, the query "why?" must come in.

Each one of the constituencies on lake Ontario and lake Erie has a small fringe or border upon the lake, and the members of parliament, at each election, the candidates for reelection seeking the suffrages of the people, have from time to time gone and made promises to the net fishermen; first, a diminution in the size of the meshes of the nets; secondly, an extension into the breeding seasons of the time in which nets could be placed; and thirdly, an increase of net licenses beyond the possibility of the water to take care of. But those same gentlemen never went into the territory of their several constituencies and told the

people there that they were making promises which must in the end take from their mouths a valuable food supply. In other words, to obtain the votes of a handful of the community, this large and important industry has practically been destroyed.

Now here is where the assistance of such organizations as I advise you to take an interest in, comes in. Most of you gentlemen, I take it, hold positions, either at the bureau of fisheries at Washington, or in other states, which largely debar you from taking any active part in politics. You will place, just as these gentlemen have done, in the reports of wastes, recommendations before your legislatures; but unless you have some force outside of yourself to back up those resolutions, I fear that most of them will meet the fate that those two have met.

Now the association which I have been instrumental in forming, the Ontario Fish and Game Protective Association, is one which I would like to call to your attention, and I have with me a number of copies of the constitution and by-laws which I shall be glad to distribute.

This organization was started in 1905, with headquarters at Toronto and branches throughout the province. It has been necessary to find people who would take an active interest and make sacrifices. It so happens that Mr. Oliver Adams and myself have been able to do that, and by making public addresses, we have succeeded in forming thirty-five branches in the last two years. The result was that we were able at the last session, to have a bill passed which undoubtedly changes the whole condition of things. I am perfectly convinced that without that association having been formed, without it having worked in an energetic manner, we never could have had the present game act passed.

I should like, in concluding that portion of my remarks, to point out a method by which blue books are often used, either intentionally or unintentionally, to mislead people. There has undoubtedly been an immense falling off in the fisheries of the Great Lakes, that is, a falling off in the weight or pounds in the catch of our waters, while the money value remains almost the same, in the value of the fish; and if you examine that report of the department of fisheries in the department of Ontario for 1906 in a casual way, your attention is not called to the falling

off in pounds, but to the fact that the values have not decreased. For instance, we find that in 1906 the total catch for this year is 23,000,000 odd pounds, and we are given a value of $1,735,000; if we turn to the year 1890, we find that the value of the fisheries for that year is over $2,000,000; the weight, however, is 29,000,000 pounds as against 23,000,000 pounds. In other words, there is a total decrease of in the neighborhood of 6,000,000 pounds, and if you average the present selling price at eight cents (for, mark you, the difference in weight is mainly in the more valuable forms of fish, such as the whitefish and trout) you would note an annual decrease of in the neighborhood of $480,000. That, of course, can be varied by the average price of the fish; I am putting it at eight cents; running it down to six cents, it would be $360,000. If you capitalize either of those sums at five percent, you will find that the capital assets of the Province of Ontario have decreased anywhere from $6,000,000 to $8,000,000. Now, here again, is where the association which I represent is able to do good work. We are able to bring these facts to the attention of the people; to dissect the blue books, and to expose what I take it are either intentionally or unintentionally, misleading statements on the part of the authorities.

Again we are able, as we have done on several occasions, by the formation of these branches, to produce definite voting strength, without delving actually into politics, where we have a large branch such as Hastings County branch. We were able, for the first time in fifty years, to make the fishermen of the Bay Canadian, one of the most important fishing grounds for Lake Ontario whitefish on the lakes, realize for the first time that there was a force outside of themselves in their waters which must and should be harkened to by the government. The fish culturist and the scientist had for years pointed out that the Bay was a natural spawning ground. We made recommendations which had not been adopted; but when the authorities realized, and when the members themselves understood, that here was a force that they must count upon, men of importance in the community, representative citizens, men who must be listened to, when they felt that there was that cohesive strength, which would be developed at the next election, and we were able to make the fishermen realize that the fish swimming in the

waters belonged to the mechanics of the city of Toronto as much as to the men living on the water front, we could accomplish something.

And it is on those grounds that I ask you, as far as it is in you power, to encourage bodies of men who may not have the same scientific attainment and knowledge as yourselves, but who may be able to help you in the work you are carrying on.

Now I should like to make a few remarks in relation to the international aspect of this case. I have heard since I have been here a great many remarks about the necessity of handing the government of the fisheries of the several states over to the federal authorities, and I quite realize that this is a necessity if you are to have uniform regulations looking to seasons, sizes of meshes and general matters. But with us on our side we have a peculiar anomaly. There is a divided authority. The fisheries of the Great Lakes on our side are regulated by the Dominion Government, while we in Ontario alone have the power of issuing net licenses. In other words, we may stop the fishing, but we cannot change the regulations. There are political reasons in the Dominion of Canada, which it would take me too long to explain, which I think take it out of the realm of practical politics to expect the province of Ontario to give up any little remnant of authority it has over the fisheries of the Great Lakes; and the consequence is that anything done at the present time in reference to some better understanding between the states and Canada must come first before the people representing the province of Ontario, not those representing the Dominion power; and in consequence I would suggest to this society that if they could first of all get their states together, to hand over to the federal government the powers in reference to the regulation of the fisheries of the Great Lakes, we in Ontario might have a better chance of getting the people to the point that they would be willing to hand over to the Dominion Government their rights as to licenses and place the whole thing in the hands of the two powers. But to start with, I think that there would be much greater possibility of success if an informal conference should be arranged between representatives of the sovereign states bordering on the Great Lakes, representatives of the province of Ontario, and representatives of the Dominion Gov-

ernment. If an informal conference of that kind should be called, it would at any rate clear the air, and it might be possible after that to have a conference commission of a more formal nature.

To show you that something should be done, and something should be done soon, I may tell you and frankly warn you that it is quite probable that within a very few years there may be passed a bill prohibiting the export of food fish from our provincial waters. Now, considering that 85 percent of our total catch comes to this country, you can realize the importance to yourselves of this question. You must remember, and you cannot fail to understand, that when citizens of Toronto have been known to buy Ontario-caught fish from Buffalo dealers, paying their own duty, the American duty, and the added freight, that such a thing, if brought to the attention of the public, will undoubtedly cause trouble. This has occurred and occurred often. The proprietor of the Clifton Hotel has placed in writing the complaint that he has to buy from Buffalo, Ontario-caught fish, and that he cannot get them from his own dealers; and his own dealers state that they have made application for fish, and that they find they are contracted for to the States. Now, there is an understanding, when licenses are issued by the provincial government, that the fishermen must supply the local market first. This has been very much ignored. As a matter of fact, there are fishermen in this town, who know that I state absolutely the fact, when I say that the ice houses, the tugs, the whole machinery of carrying on the fishing industry of Lake Superior and Lake Huron is entirely in the hands of what might be concisely termed, "the American fish trust." Now, gentlemen, there is a feeling in our country that we are being turned into hewers of wood and drawers of water; that we are getting a very small sum for this 85 percent of the fish that is coming over here; and when that feeling is added to by other little frictions that may come up from time to time, you will see that there is a possibility of the prohibition of the export of food fish. If within the next two or three years, you are able to take up such an informal conference, as I suggest, and if that conference is able to come to definite conclusions on two or three important basic points; for instance, that no fish that has not

reached a size capable of reproducing its species can be caught, and that nets and machinery for catching fish are regulated upon that principle, also that in the markets no fish beneath such regulated size would be allowed by law to be sold; if all that is done, I firmly believe that it will withdraw a good many of the reasons which are tending in the direction of a possible prohibition of the export of the food fish. And therefore, on those grounds alone, I ask your earnest cooperation. I ask your efforts especially in the direction of getting up such an international conference. There are political reasons why such a suggestion can hardly proceed from the province of Ontario; but if such a suggestion should be received from the great sovereign States, bordering upon the Great Lakes, I believe that it would be heartily met by the authorities both at Ottawa and Ontario.

In speaking in this way, recollect, gentlemen, that I am simply the working head of this association, because I think so many of you are connected with bureaus of different kinds, that you might possibly imagine I was connected with some bureau in my own country. I have no connection whatever with the government, nor do I receive, nor does my association receive, any support from the government. In fact, in many ways we are making it a little bit embarrassing and unpleasant for the government, in the direction of trying to make them carry out the laws they have put on their statute books.

In closing, I will simply quote from the report of Mr. Tinsley on pages eight and nine of the 1906 issue of the report of the department of fisheries of the province of Ontario, to show you that the remarks which I have made, as it were as an independent person, an absolute free lance, having no strings upon me, are borne out by an official occupying the position of a deputy head of the department of fisheries of the province of Ontario.

He says:

"The Great Lakes Fisheries."

"During the past year little has been done in the matter of harmonizing the fishery laws and regulations applicable to international waters. Although this important matter has to some extent been in abeyance during 1906, it has not been lost sight

of, and will no doubt receive the consideration it is entitled to in the near future."

Referring to this matter in the report for 1905, the then deputy commissioner of fisheries did so as follows: "The circular letter which in 1904 was addressed to every licensed fisherman in the province notifying him that he must make arrangements for supplying the local demand for fish does not appear to have received that attention which was hoped and expected. This is a question of dollars and cents, and not of patriotism or sentiment. It rests with the public and not with the fishermen to establish a home market, which can only be accomplished in two ways, namely, by the Dominion Government prohibiting export, or residents of the province being prepared to pay the price for Ontario fish they realize in the United States."

You see, gentlemen, there are just two ways, and if the people say, we will have our own fish, they will choose the former way.

"The public fail to recognize the changed conditions from those prevailing fifteen years ago. At that time the fresh water fisheries of the United States had not been depleted, neither was the fishing business of Ontario controlled by powerful American combines. Not many years back, fishermen on the shores of Lake Erie were satisfied to sell herring at one cent per pound, whitefish and salmon trout at five cents a pound—the price now realized in many markets for the much abused carp. However desirable it may be to have our home markets abundantly supplied with good wholesome fish, this will not occur under present conditions, but our fish will reach those markets paying the most for them.

As to the ownership of the gear, tugs, boats, nets, etc., etc., operated by the fishermen. Such enquiry is not required, if, as stated in report for 1905, this department found, upon assuming the administration of the fisheries in 1898, that the fishing industry of the Great Lakes was largely controlled by American companies. If American ownership and control prevailed in 1898, we may rest assured that such control prevails now to a far greater extent than in 1898. We have the most convincing proof of American control when we revert to the well known fact that at least three-fourths of the fish caught in the Great Lakes

by the licensed fishermen of the province reach the United States direct from the nets, thus evading with impunity espionage or inspection by provincial officials."

Now you see, gentlemen, there is where you put your finger on what is a sore spot to us. If we had an international agreement as to the size of the fish, we would know that the fish was legally caught and legally shipped; but when we know as a positive fact that large quantities of fish way under our legal size are going into your markets, it rises in the gorge of our people. And that is another reason why again I plead with you to try and bring about some interprovincial and interstate informal conference and try and arrange these matters so that we can get along much better together.

"To devise means for effective inspection is urgently required, and not further proof of ownership and control by American fish companies, a fact already so well established. The fish of our lakes, rivers and streams are a grand heritage left us by nature to be used wisely for the benefit of all, and not for the purpose of being exterminated to satisfy the greed and rapacity of a few powerful and dominating alien fish companies."

Now, gentlemen, that is language stronger than I have used, and that is language from the deputy head of the department of fisheries of the province of Ontario.

With those facts in view, and with the knowledge that you have in reference to the fisheries of these Great Lakes, in which you are undoubtedly as much interested as we, and in which we have as great a share as you, I do trust and hope, gentlemen, that you will in a sense forget during your labors sometimes the more scientific and interesting portions of the work of the society, and remember the practical application of the theories and experiments you are so nobly carrying out.

One thing which I have learned since I arrived here has given me a great deal of pleasure, and that is the tremendously good work being done by your several commissions. I find from Mr. Meehan that some 600,000,000 of fry have been put in the waters mainly in the lakes alone, from his hatcheries, and I do think that even if you are getting 85 per cent of our fish, you are certainly putting in ten times as much fry as we are; there is no question or doubt about that. I have to apologize in a sense

for our want of work in the direction of hatcheries; but I do believe, (to show you the importance of the interprovincial informal conference I have suggested,) that if you all got together in that way, when the officials appointed by the dominion and the provincial governments meet you and see the great work you are doing in restocking hatcheries, that they would be shamed into placing more money in the estimates for these purposes, and that we should have, as we ought to have, just as fine hatcheries as Mr. Meehan so splendidly carries on here in Pennsylvania.

Gentlemen, I thank you for the kind way in which you have listened to me. If I have made any remarks that may at all offend you, I am indeed sorry; but I am working, as I believe, for the best interests of the province in which I was born, a province, gentlemen, that is larger I think than any of your states with the exception of Texas, a province that has immense possibilities, and a province which will shortly build a railroad to Hudson Bay and make it possible to transship to your markets some of the finest salt water fish in the world. And again, I work because I want, by the time that railroad touches Hudson Bay to have public opinion so wrought up over the proper regulation of the fisheries we possess, that it will not allow that magnificent body of water to be depleted as most of our other lakes have been. (Great applause.)

MANIPULATION OF SALMON EGGS

BY CHARLES G. ATKINS, EAST ORLAND, MAINE.

It is my purpose in this paper to state only the methods in vogue at the stations in Maine that have been under my personal direction, of which the primary one is at Craig Brook in the town of Orland and county of Hancock. The kinds handled have been the sea-going Atlantic salmon, *Salmo salar* and its landlocked variety, *Salmo salar sebago*. Several species of trout have been propagated and their eggs have been handled in substantially the same way. It will therefore place the methods fully before you, if I confine myself to the work on the sea-going Atlantic salmon. There has been some change in the apparatus since the inception of this work in 1871, but for now some twenty years apparatus and methods have been practically unchanged.

The eggs of Atlantic salmon are all taken from adult fish collected by purchase from the commercial fishermen in and about the mouth of the Penobscot river during the months of May and June each year. All these fish are fresh from the ocean and are in prime condition, smooth, bright and fat. It being impracticable to distinguish the sexes at that season of the year, no attention is paid to that matter in collections, nor is any distinction made as to size. But it always turns out that the majority of the salmon collected are females and while the size ranges from eight to thirty pounds weight (rarely outside of these dimensions above or below) the mean weight is somewhere between 11½ and 13½ pounds. The salmon collected are conveyed in floating cars from the places of capture to an enclosure in a fresh-water stream, where they pass the summer and autumn, until the spawning season, which begins between October 20 and 25. They are then brought into narrow quarters, dipped up and examined, one by one, and as fast as they are found ripe the spawn is taken.

The spawning party works under a shed snug by the bank of the enclosure. The spawn-taker sits on a box with a common tin milk-pan before him. Seizing a female fish by the tail with his right hand he holds her up for a moment to judge by the

appearance of the abdomen whether her eggs are ripe, and then, if she is ready, swinging her head under his left arm so as to allow the left hand to be used in pressing the abdomen, he holds her over the pan and, as soon as her first struggling is over, presses out the spawn in a leisurely way taking, however, rarely more than ten minutes in the operation. As soon as the female has yielded her eggs a male is taken in the same way and his milt expressed upon the eggs. The eggs and milt are then thoroughly mixed together by shaking and whirling the pan about. Then for the first time water is added by a second operator, who repeats the mixing motions and very shortly washes the milt all off, fills up with clean water and sets the pan of eggs on a shelf to swell. This process being completed, the eggs are, as soon as convenient, generally after the lapse of several hours, spread upon the wire-cloth trays on which they are to be incubated, enclosed in light-tight boxes and transferred to the hatchery, which transfer involves carrying over rough ground by foot-porters and by boat across a lake, a total distance of nearly two miles.

Arrived at the hatchery, the eggs are removed from the box and, on the same trays on which they are brought, are placed in movable frames in wooden troughs fed by water from a brook whose source is a small lake of exceptional purity located at a much greater elevation, from which the water comes tumbling down over rocks and ledges and arrives at the hatchery well aerated. The temperature of this water during the past year ranged from 50° F. at the end of October and a mean of 42.5° F. in November to a mean of 33.2° F. in February; being a little more than one degree warmer through March and attaining a mean of 36.6° F. in April and 45.5° F. in May. The progress of development is of course very slow in such cool water, and the period of incubation is about five months.

The water in the troughs has altogether a horizontal flow. The trays are constructed in such a way that while resting on each other at the corners there are narrow interstices between them reaching across each side, which are sufficient to admit water in ample volume to nourish the eggs, but not deep enough to allow salmon eggs to be washed out should the flow be excessive. In this system no use whatever is made of vertical cur-

rents of water, either up or down, and the dispensing with them has several advantages, among which may be mentioned the saving of expense in construction, and such a simplification of the trough that as soon as the frames carrying eggs are lifted out it is ready for fish. These frames, locally termed "stack-frames," are made of square wooden bases with vertical corner pieces of sheet metal which reach up to the surface and hold all of the trays in place by clasping them at the corners. These stack-frames, with their contents, are lifted at pleasure by means of hooks which are held in the hands and inserted in perforations in the corner-pieces, and any stack can be taken out without in any degree interfering with the neighboring stacks. There are in use two depths of troughs: the 9 in. trough, a stack for which carries 20,000 salmon eggs, or 140,000 or more in a trough 10 ft. long; and a 17 inch trough which carries twice as many in the same length.

When the eggs are picked, which is generally once a week, (the low temperature not requiring it oftener) the stacks are one by one lifted from the trough and carried in a shallow but tight box to the picking table where the light is ample and the operator can stand erect in a position most favorable to both personal comfort and effective work. The trays are now inspected, one by one, the dead eggs removed, and the tray transferred to another stack-frame which stands alongside, having been rinsed in clean water meanwhile if that appears desirable. When all the trays have thus been picked and placed in the new frame, the latter with its contents is returned to the trough. The whole operation is simple and quickly performed. The exposure of the eggs to the air while out of the trough does not do the slightest harm if the room is cool—we aim to keep it below 55° F. With only ordinary care it is easy to handle the eggs so gently that not the slightest harm is done to them even at the most delicate stage, and picking is never intermitted on account of stage of development.

I have been thus minute in describing these operations with the hope of thereby drawing a vivid picture of a system which appears to me to meet all the requirements better than any other of which I have heard. I may add that I know of no other system that appears to be so well adapted to the meeting of

emergencies. Should it be inconvenient to transfer the eggs from the place of capture to the hatchery at once, the whole stack can be set into a brook and rest there over night or even longer. In case of a sudden failure of water in the hatchery, or of the building taking fire, it is but the work of a very short time to remove the eggs to a place of safety. If, in such an emergency, another place in water cannot be immediately provided, the stacks of eggs can be placed in a cellar or other place where extremes of temperature can be avoided and there wait safely for several days the preparation of a place for their reception. No system known to me is so independent of a fall of water at the hatchery. It is possible to safely carry eggs through the whole period of incubation up to the point of hatching, with half an inch fall in 10 feet. Should there be no available site for developing-troughs on the land, it would be quite possible to use a floating trough, with an opening at each end for ingress and egress of water, of any size demanded by the strength of the current. This might be a very useful arrangement at some collecting stations: the eggs could remain as many days as convenient in the floating trough and then taken out and transferred on the same trays and in the same stack-frames to even a very distant hatchery; and by taking the precaution to pack the space between each layer of eggs and the tray above it with soft material—say moss between pieces of cloth—this transfer can be made successfully at the most delicate stage of development. This was actually done with a lot of salmon eggs transferred in November, 1904, from Craig Brook to the auxiliary station at Little Spring Brook on the upper Penobscot river, a distance of 114 miles, of which 120 miles was by rail, 7 miles by wagon on a rough road and 17 miles on a sled. The eggs were packed Nov. 14, started Nov. 15, and reached their destination Nov. 16; and the loss en route was less than one per cent. Among other eggs in the same package, all at the stages when handling is usually avoided, there was one lot of 2,200 eggs, 13 days from impregnation, (in water of 46½° F. Nov. 1 and 42° F. Nov. 14), in which the embryo had spread to cover one-third of the surface of the yolk,—a very delicate stage. In this lot but three dead eggs could be found on unpacking and 14 the next day.

The water supply to the hatchery is only roughly filtered and

there is considerable deposit of sediment on the eggs. It is customary to wash this off at the time of picking by dipping the tray of eggs in a pan of water, but close observation has shown that this may safely be omitted. Eggs have been allowed to go unwashed until the sediment was so thick on them that it was no longer possible to distinguish between a normal egg and a white one, yet not the slightest harm followed. Undoubtedly the embryos are sufficiently nourished by the current of water flowing underneath the tray and having free access through the coarse meshes of the wire-cloth to the clean underside of the eggs.

The question of the exhaustion of the life-giving properties of the water by ministering to so many eggs was also looked into, and it was found that the eggs at the foot of the trough, which received only water that had already passed through 6 or 7 stacks of eggs were equally well nourished with those at its head.

The elimination of the unimpregnated eggs is effected by concussion. When the eggs have reached the stage at which they are usually transported, or a little earlier, they are turned from the trays into tin pans with water and then poured back and forth a dozen times, the eggs striking hard against the bottom of the pan, so as to give each egg a severe shock. After this the eggs are returned to the troughs and left until next day, when it is found that all the unimpregnated eggs have turned white, but that the impregnated are not injured. This operation is always attended to before eggs are packed for shipment, with the result that the loss en route is exceeding small.

The quality of the eggs resulting from the manipulation described, and that of the fry subsequently hatched have always been the best possible, indicating the efficiency of the methods.

THE RESPIRATION OF AN INLAND LAKE

BY EDWARD A. BIRGE,

Secretary of the Commissioners of Fisheries, Wisconsin

An inland lake has often been compared to a living being, and this has always seemed to me one of the happiest of the attempts to find resemblances between animate and inanimate objects. Unlike many such comparisons, which turn on a single point of resemblance and whose fitness disappears as soon as the objects are viewed from a different position, the appropriateness of this increases rather than diminishes as our knowledge both of lakes and of living beings is enlarged.

The lake, like the organism, has its birth and its periods of growth, maturity, old age, and death; and this fact is an obvious one, for of all the larger features of the landscape, the lake is the youngest and the most temporary. Its birth lies in the recent past and in no very long space of time its existence must come to an end. In any lake district, lakes may be found in all stages of maturity and decay, and many dead lakes will be seen, —places where lakes once existed which are now extinct. Lakes show not only the cycle of individual existence, but also the rhythm of seasonal activity. The activity of the lake in summer, both physical and vital, contrasts sharply with its torpidity in winter. And the lake resembles the organism not only in its annual recurrence of activity. The comparison may be pushed further and extended to the minor fluctuations of the vigor of vital manifestations which characterize lake and organism alike.

In all these points, and in many others, the lake resembles a living being; but in no respect does it resemble an organism more closely than in the topic on which I am going to speak to you, namely, its respiration. In this comparison, the resemblance is rather in processes and operations than in form. The lake is morphologically a very simple creature, resembling rather a gigantic amoeba than a more highly organized being. Perhaps it would be better to compare the lake, for the purpose of this subject, not with the organism as a whole, but with the special respiratory substance of the animal—the blood.

Like the blood of the higher animals, the lake consists of

an unorganized fluid—the plasma of the blood and the water of the lake—and of numerous organized and actively living parts—cells in the case of blood, and the plants and animals in the lake. As is the case in the animal, the respiratory gases are absorbed and transmitted to the living structures by means of the unorganized fluid. It is my purpose to trace in outline the history of these processes and their result upon the activity of the lake.

The respiration of the lake, like that of the higher animal, may be divided into external and internal respiration. By the former we understand the absorption of certain gases from the air and the return of other gases to it, as well as the processes by which this exchange is effected. We include in it also the methods by which the gases are distributed in the lake and conveyed to and from the surface of the water, which takes them from the atmosphere and gives them back to it. By internal respiration we mean the gaseous exchanges which take place in the lake itself, between its various organisms and the water surrounding them. With these exchanges come the chemical processes by which the character of the gases is altered or new gases manufactured, in the course of the vital activities of the inhabitants of the lake.

The external respiration of the lake closely resembles that of the organism. The lake absorbs oxygen, carbon dioxide, and nitrogen from the atmosphere and returns to it nitrogen, carbon dioxide, and sometimes other gases. The nitrogen absorbed by the lake, like that taken in by an animal, has very little or nothing, to do with the vital processes. In autumn, as the lake cools, larger amounts of nitrogen are absorbed, according to the general law of absorption of gases. As the lake warms during the summer season, the capacity for holding gases in absorption becomes smaller and some of the nitrogen is lost. This process is a purely physical one and has apparently no influence on the life of any of the organisms whose home is in the water.

The relation of the oxygen to life is, however, far different, and the processes of external respiration are of prime importance to the living beings of the lake. Speaking roughly, and in terms of our comparison, we may say that an inland lake is an organism which takes one full inspiration in the fall, and another, less complete, in the early spring; that during the winter it

does not breathe at all and during the summer has only a very shallow and imperfect respiration. As the lake cools in the fall the temperature becomes uniform from top to bottom at a date which will vary from late September to late November or early December, according to the area and the depth of the lake and the consequent temperature of the bottom water, the volume of water to be cooled, and the vigor of the cooling processes. When the temperature has thus become uniform, the water of the lake is readily moved throughout its entire depth by the wind. It is turned over and all parts of it are brought into contact with the atmosphere. As a result, inland lakes, even those whose depth is two hundred feet or more, become almost, or quite, saturated with oxygen at a temperature but little above the freezing point. This quantity amounts to about 10 cc. per liter, or about 1 per cent by volume; nearly twice as much as the water will hold at the highest summer temperature. In this condition as regards oxygen the lake goes into winter quarters, becomes covered with a sheet of ice in our latitudes, and is, therefore, shut off until spring from all further direct connection with the atmosphere. During this period the stock of oxygen is used up to some extent, especially in the water adjacent to the bottom. But as the vital processes of both plants and animals, and also those connected with decay, go on slowly at the low temperature of the water in winter, the amount of oxygen thus consumed is comparatively small, and most lakes contain an abundance for all forms of life at all depths, except perhaps in the strata very close to the bottom. This statement, though generally true, will not hold universally: In some ponds which are shallow and contain a large amount both of living organisms and of decomposing matter, the oxygen beneath the ice may become wholly used up. We all know of lakes, which become so poor in oxygen that if a hole is cut through the ice in late winter, the fish will crowd to it for air so eagerly and in such numbers as to be forced out on the ice. There are on record cases where an unusual exhaustion of the oxygen below the ice of a lake has caused the death of most of the fish. Such cases, however, are not common, and in the great majority of lakes the consumption of oxygen in winter does not go far enough to affect unfavorably their living inhabitants.

Associated with this partial exhaustion of oxygen, there is an increase during winter of the amount of carbon dioxide—the main gaseous product of respiration. This is not present in any observable quantity in the lake at the time of freezing but it increases during the winter and the quantity at the bottom may become very considerable. The amount will be, in general, proportional to the amount of oxygen used up.

In the spring, when the ice has melted, the water of the lake is once more uniform in temperature. It is put into motion once more by the wind and all parts of the water are brought into contact with the air. The carbon dioxide, which has been accumulating during the winter, is discharged and the lake again becomes nearly saturated with oxygen. But, as the temperature in spring is higher than in the autumn, the amount of oxygen taken in is less; and since the temperature of the water continues to rise, the stock of oxygen is being diminished from this cause quite independently of any use made of the gas by the organisms of the lake.

The period of full oxygen saturation in the spring is a very brief one in our climate. The season advances rapidly and the surface water soon acquires a higher temperature than that at the bottom. This warmed water is, of course, lighter than the cooler water below and tends to float upon it. The difference in density thus caused makes it increasingly difficult for the wind to create and maintain a complete circulation of the water. For a time the action of the wind may continue to mix each successive stratum of water with that below it, the mixture extending to the bottom of the lake. But this action is a very different thing from the complete overturning of the water, and while it results in raising the temperature of the lower water, it does not carry freely oxygen to the bottom. Thus, when the surface becomes decidedly warmer than the water below it, the bottom water, though it continues to warm, is withdrawn from direct contact with the air and is therefore at a disadvantage in the matter of gaining a new supply of oxygen.

As the season advances this stratification of water dependent on temperature becomes accentuated, and, in the way of which I spoke last year and need not now repeat, the lake becomes separated into two parts: an upper warm stratum of nearly uniform

temperature, beneath which lies the cold water, consisting of a transition layer—the thermocline—in which the temperature is rapidly falling, and below this the mass of the cold water, whose temperature ordinarily falls rather slowly with the depth until the bottom of the lake is reached. The thickness of the upper layer varies with the size of the lake, from ten or twelve feet to thirty or forty feet. It is present as a definite and permanent layer at a date varying with the area of the lake from late April to the middle of July. It increases in thickness after the cooling of the lake begins but does not change much before that process commences.

This upper layer is subject to the direct action of the wind; is kept in circulation, and may be saturated with oxygen, or nearly so; but the only new supply of oxygen which the lower water can gain must come to it indirectly from the upper stratum. This condition of permanent stratification of the water comes on at the time when the life of the lake and its consequent need for oxygen are rising to the maximum, with the increasing warmth of summer and the development of life. The consumption of oxygen for the purposes of decomposition is also at a maximum. The separation of the lower water from the atmosphere in summer by a thick layer of warm water is therefore a much more serious thing than the separation of the water from the air in winter by ice. In winter the demand for oxygen is at a minimum and the stock contained in the water is at a maximum. In summer both of these conditions are exactly reversed. It is therefore necessary for us to inquire as to the means which the lake has for absorbing oxygen from the air and its means of transporting the gas from the surface to the place where it is to be used, and to note the efficiency of these processes as compared with the call for oxygen in the summer life of the lake.

The absorption and distribution of oxygen constitutes one of the fundamental problems of life for any large and active organism. The difficulty of solving the problem is increased by the fact that no large reserve stock of oxygen can be maintained. In the case of a human being there may be a food supply in the tissues sufficient to sustain life for weeks, even though no new supply is taken in. There is water enough in the body to main-

tain life for days; but if the supply of oxygen is shut off, life can be continued only for a very few minutes on the stock of oxygen contained in the body. So narrow is the space between abundance of oxygen and death from oxygen starvation. In a cold-blooded animal—with which the lake ought to be compared—processes of respiration are slower but the relative situation is not materially different. The result of these conditions is that in any large animal enormous surfaces must be provided for the absorption of oxygen and there must be a perfect mechanism for its distribution. Such respiratory systems exist in a great variety of forms, many of which are extremely complex and efficient. In the case of man the absorbing surface of the lungs is said to amount to about two thousand square feet—an area as great as the combined surface of floors, walls, and ceiling of a room 20 feet square and 15 feet high. The necessity for arrangements for a large absorbing surface increases with the size of the animal, since in a large organism the area of the general surface is far smaller in proportion to its mass than in a small organism of the same shape. In a lake, whose size is enormous as compared with that of any living being, the absorbing surface is very small as compared with its mass; being only the upper surface of the water. The lake is, therefore, at a great disadvantage in the matter of absorbing oxygen as compared with the animal. Still further, all higher animals, both cold-blooded and warm-blooded, contain in their blood some chemical substance which has a special affinity for oxygen and which can rapidly pick up large quantities of it. Such a substance is wholly lacking in the water of the lake, whose respiratory power is correspondingly smaller, both as regards the rapidity with which oxygen can be taken up and the amount which can be absorbed. It is indeed true that water will absorb, according to the general laws of the absorption of gases, about twice as much oxygen as nitrogen under similar conditions. This fact allows the lake to take in a larger stock of oxygen than would otherwise be possible, and that part of the atmosphere which is dissolved in the lake contains about one-third oxygen instead of one-fifth, as is the case outside. But even this amount is very little in comparison to the enormous volumes which a substance like haemoglobin can take up. It is also true that the mass of the water of the lake, in

comparison to the mass of the organisms which draw their oxygen from it, is relatively far greater than the mass of the blood with reference to that of the cells which take their oxygen from it. Yet is it none the less true that the supply of oxygen in most lakes is very small as compared with that of an animal, and the mechanism for renewing it is always very inefficient as compared with the demand for the gas.

The disadvantage of the lake in the matter of respiration appears still more clearly when we consider the means of transporting the oxygen from the region where it is absorbed—the surface—to the deeper parts of the lake, where much of it is to be used. The animal shows a complex and very efficient mechanism for the circulation of the blood; an apparatus whose complexity and efficiency are in large measure determined by the necessity for a rapid distribution of the oxygen and a rapid disposal of the gaseous wastes of the body. In the lake the means of transport are three: diffusion, by which the gas is slowly passed from point to point in the water independently of the currents; currents produced by the wind; and convection currents, produced by the cooling of the surface water to a temperature below that of the water beneath.

Diffusion is a process which operates rapidly when the distances are minute, but whose efficiency decreases greatly as the distances increase. In our lungs, or the gills of a fish, for instance, where the distance between blood and air is measured in thousandths of an inch the process of diffusion goes on with great rapidity. But where, as in the lake, the distances are measured by inches or by feet, or even by scores of feet, the process is practically worthless for the processes of distribution. By diffusion alone oxygen would penetrate the lake only to the depth of a very few feet in a whole season. While diffusion, therefore, plays an active and important part in the exchange of gases between the individual plant and animal and the water immediately surrounding it, it has little or nothing to do with the general circulation of gases within the lake.

During the fall, when the lake is cooling, convection currents aid materially in carrying oxygen down to considerable depths. The surface water, saturated with oxygen, cools, becomes heavier, and sinks, carrying the gas with it. The same

process takes place at night in summer, but ordinarily to very small depths. In general, we may say that during early and midsummer, before the period of general cooling begins, these processes do not extend to greater depths than ten or fifteen feet. At the season, therefore, when vital processes are most active and the need for oxygen is greatest, convection currents afford a minimum of assistance in distributing it. The main reliance, therefore, for the distribution of oxygen is in the third factor, the wind. This, as already said, is very efficient when the lake is uniform in temperature; but during the spring, as the lake warms, it becomes increasingly ineffective and during the summer its action is confined to the upper warmed layer of the lake, and the lower, cooler water is wholly shut off from the direct influence of the wind currents.

These facts show that an inland lake has an extremely inefficient apparatus for absorbing and distributing oxygen and the net result is that in many lakes the amount and character of the higher life which the lake will support are conditioned by the amount of oxygen which the lake contains rather than by the amount of food which it can produce. The oxygen in the lower and cooler water of the lakes cannot be renewed between spring and fall. This amount would be indeed ample to sustain a large amount of animal life in full activity. But its use cannot be confined to the necessities of ordinary life. The processes of decomposition draw upon it much more heavily than does the animal or the ordinary vegetable life. All the plants and animals of the upper water, which die and sink into the deeper strata, the leaves blown into the lake, and the material washed in from the shore, decompose in the cooler water and in the process of decomposition use up a great amount of oxygen. This depletion of the stock of oxygen goes on with a rapidity which varies with the amount of decomposing matter dropping into the lower water; with the temperature of the lower water, which to some extent regulates the rapidity of decomposition; and with the depth of the water, on which depends the quantity of oxygen contained in it. Each of these factors may and does differ in different lakes, but the result is that in a very large proportion of our inland lakes the bottom water loses its stock of oxygen comparatively early in the season and becomes un-

inhabitable for higher animals. This fact excludes from our lakes a good many kinds of animals which they might otherwise support, and very greatly limits the quantity of the higher life which the lake is able to maintain. A lake which loses its bottom oxygen, for example, cannot support a fish, as the lake trout, which must retire to the deeper and cooler water during the summer. To such causes may probably be attributed a considerable number of our failures in the planting of fish in our inland lakes. From causes such as these, the whole of the lower water, containing half, or more, of the volume of the lake, may become uninhabitable during the season when life is most abundant; and the quantity of life which the lake supports may be correspondingly limited.

Still further, since the rapidity with which the oxygen is exhausted depends on the amount of material which is deposited in the lower water, those lakes whose upper water contains the greatest quantity of vegetable life, and which can therefore support the greatest amount of animal life, use up the oxygen of the lower water most rapidly. It looks, therefore, as if we were in a somewhat unfavorable situation as regards the possibilities of higher life in the lower water of inland lakes. Those lakes whose food supply is such that they are capable of supporting large quantities of animal life—I may say for our purposes, large numbers of fish—are likely from that very fact to exhaust the stock of oxygen in the lower water, which thus becomes uninhabitable; while those lakes whose lower water is fully habitable are likely to be so poor in organic life that they can support only a limited number of fish. It may be that further study will show that this relation is not so unfavorable as it now appears, but at present we must face the probability that it exists.

A noteworthy exception to this statement should be made in the case of very deep lakes—lakes two hundred or more feet in depth—in which the quantity of the lower water is so great and the consequent amount of dissolved oxygen is so considerable that no ordinary amount of decomposing material can exhaust it or materially reduce it. This is the case, for example, with Green Lake (237 feet in depth) in Wisconsin, and the same statement would doubtless hold for the deep lakes of New York

and similar bodies of water. Such lakes may support an abundant population of fish both in the warmer and the cooler water. If they do not do so, the fault does not lie with the oxygen supply.

Thus we see that if we desire to determine the capacity of a lake for the development of higher life, we must consider not only its capacity for food production but also its respiratory conditions. It may be that an imperfect respiratory mechanism renders a very large share of the bottom of the lake wholly uninhabitable for animal life; that while, for instance, mud-living insect larvae may be found in the mud around the lake to a depth of twenty or thirty feet, they are excluded by the absence of oxygen from the entire bottom of the lake beyond this depth, an area of perhaps many square miles. The supply of food which the lake offers to the higher animals may thus be greatly limited by the lack of oxygen. It may be true also that the greater part of the volume of the water of the lake is uninhabitable for similar reasons, and that a lake whose surface appearance would indicate that it is capable of supporting enormous quantities of fish life may be very considerably restricted in this respect by its respiratory capacity. Each lake should be studied both as to food and oxygen if an intelligent economic use is to be made of its waters; and when this is done, the possibilities of use will often be found to depend on the respiratory mechanism.

I have said nothing on another side of the methods of absorbing and transporting gases in a lake. The same processes which take oxygen from the surface bring waste gases to it and they are as efficient or as inefficient in the latter process as in the former. Processes of absorption and transportation have much to do with the story of the complex relations of carbon dioxide gas in the lake. These matters, however, can better be spoken of under internal respiration. I need only say here that the accumulation of waste gases in the lower water does not seem to affect life unfavorably if there is plenty of oxygen present also. Respiratory inefficiency limits life in a lake because of lack of oxygen rather than because it allows poisonous gases to collect in large quantities.

The subject of internal respiration deals with the changes

of gases within the lake itself and with the manufacture of gases by the organisms which inhabit it. No branch of physiology is more intricate and none less understood than is that of internal respiration. This is true also of the internal respiration of the lake. The gaseous exchanges and the manufacturing operations in the interior of a lake are far more complex than those of any animal. From the water living beings are drawing supplies of gas, each after its kind, and to the water each is contributing gases differing in amount and composition. Animals are withdrawing oxygen from the water and giving carbon dioxide to it. Algae are repeating this process by night and exactly reversing it by day. Fungi and bacteria are using oxygen in the course of their internal vital activities; they are employing far larger quantities in the fermentative processes which they maintain. The numberless chemical changes included under decomposition and fermentation, going on under all sorts of conditions, involving numerous kinds of materials, and operated by various organisms, are adding to the water gases of different kinds and in varying proportions. The upper water, the lower water, and the mud present very dissimilar fields of work to the organisms which inhabit them. It is, therefore, impossible even to attempt a picture of the internal respiration, with the innumerable operations, each adding to or subtracting from the sum of gases in the lake; in an intricate network of processes, consecutive, correlative, and antagonistic; connected by relations which cross and interlock at a thousand points. I shall speak of only a few detached topics.

I have said that the oxygen of the lake is absorbed from the air. This is true so far as the main stock of oxygen is concerned; but a lake has a second source of oxygen which is always considerable and which in certain places and relations may become important. The green plants which inhabit the lake are able to take up carbon dioxide from the water, and under the influence of light they can use it in the manufacture of starch, setting oxygen free in the process. In lakes which contain an abundance of algae, considerable quantities of oxygen may arise from this source and this manufactured oxygen may play an important part in the vital history of the lake.

Consider the effect of the addition of this power of the algae

to the numerous factors which are affecting the supply of oxygen in the upper water of the lake in summer. If the oxygen of this region is studied, it rarely happens that the quantity found is the amount which would be theoretically expected, according to the laws of the absorption of gases by water at different temperatures. It is sometimes largely in excess of the theoretical amount, and sometimes is considerably deficient. The fact is that the amount of oxygen in the upper water of the lake is the result of very numerous and variable forces. The lake may or may not be absorbing oxygen from the air. If saturated, it will give off oxygen to the air as the water warms, or will take it in as it cools. Both of these processes go on somewhat slowly, as the oxygen is not given off or absorbed as rapidly as the rate of cooling and warming varies. Into the water the green plants are discharging oxygen during the hours when the light is sufficiently strong; from the water both plants and animals are taking oxygen to assist their vital operations; and the process of decomposition is aiding to exhaust the stock of oxygen. Thus the amount present at any given moment will depend on the relative value of these forces; some of them positive; others negative; and all varying not only from day to day but from hour to hour. Nor do these factors exhaust the list. The wind has something to do here. During a calm period the oxygen content of the upper water may differ from that of a stormy period. The vital condition of the successive crops of algae, as they come and go, may determine for the time, the predominance of the manufacture of starch, with accompanying liberation of oxygen, or decomposition, with partial exhaustion of oxygen. Thus the ability of the green plant to set free oxygen into the upper water may be of great value in maintaining the supply of the lake.

This power may be far more important in the lower water. If the transparency of the water and the thickness of the warm layer are such that a good deal of light can penetrate to the colder water, algae will be able to manufacture starch in the upper part of this stratum. Thus in the region which is practically cut off from access to the atmosphere, large amounts of oxygen may be set free. There may be enough not only to serve the ordinary needs of the stratum, but the water may be satur-

ated or even over-saturated with the gas. I gave several instances of this process in my address last year and need not repeat them at this time. I give the diagram of Elkhart Lake

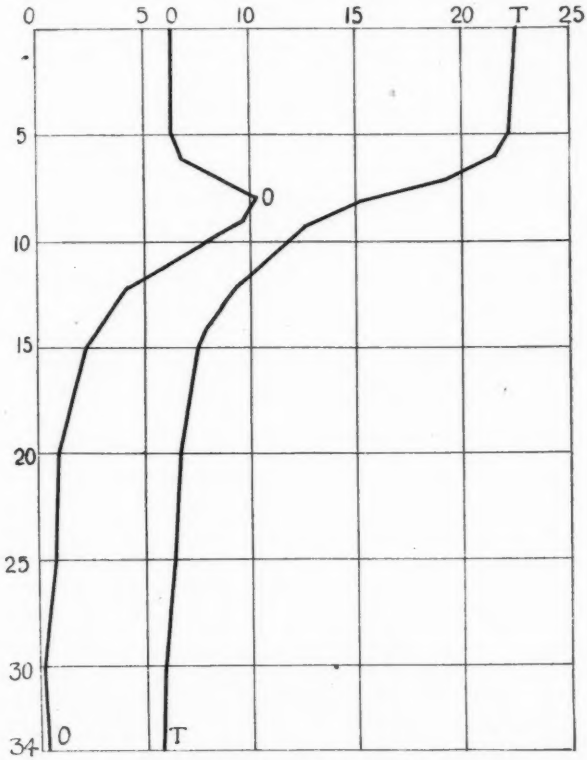


FIG. 1. — Elkhart Lake Aug. 23, 1905

This diagram represents the condition of Elkhart Lake with respect to temperature and oxygen. The vertical spaces represent meters of depth. The horizontal spaces represent two things: (1) degrees centigrade, as indicated by the temperature line (T—T); and (2) cubic centimeters of oxygen per liter, as represented by the oxygen line (0—0); or the oxygen is indicated as parts per thousand, by volume. It is easily seen that the temperature of the water begins to fall rapidly at about 6 m. and that the oxygen begins to rise rapidly at that depth, reaching a maximum of more than 10 cc. at 8 m., and decreasing from that depth. A very important addition is made to the oxygen stock of the lake by this manufactured gas.

from that paper, which shows clearly the position and amount of this manufactured oxygen, and the addition which it makes to the thickness of that part of the lake that has abundance of oxygen. Lakes whose habitable portion would otherwise be only twelve to twenty feet in thickness may have this depth doubled by the presence of the manufactured oxygen. The plants in this undisturbed cooler water find a peculiarly favorable situation for growth. They obtain for their food the products of decomposition, which is taking place rapidly in the lower water; and not infrequently a far larger amount of organic life may be found in these strata than in any other portion of the lake. This process is necessarily limited to lakes whose upper warm layer is thin, and is confined to the upper part of the cold water, since only there can the light have sufficient intensity to carry on the operation. But even as thus restricted, it is of great value to some lakes.

I have said little hitherto of the carbon dioxide—a gas whose importance is quite equal to that of oxygen—and now can only sketch a part of its complex story. This gas plays many roles in the respiration of the lake. It is at once the waste product of the tissue activity of plant and animal, the product or by-product of decomposition, and the indispensable food of green plants. The lake may obtain the gas from the air, and to some extent does so. Carbon dioxide exists in the atmosphere in very small amount—about four parts in 10,000. Minute as this quantity is, the land plants are able to secure from it ample supplies of carbon. The movement of the air is so free and such enormous quantities pass over the surface of the plants, that they readily pick up the gas in large amounts. But the situation of the algae and other plants of the lake is very different, as they must secure their carbon dioxide through the intermedium of the water. This readily absorbs large quantities of the gas. But the percentage existing in the air is so small, the absorbing surface of the lake is so restricted, and the means of transport are so poor that the lake is quite unable to take from the air enough carbon dioxide to maintain a vigorous growth of plants. The lake is forced to depend on its own resources to a large degree for this plant food. Fortunately, these resources are considerable. Great amounts of carbon dioxide are manu-

factured in the lake as the result of decomposition and these may be utilized as food by the green plants. Thus there is kept up in the lake a sort of internal circulation of carbon dioxide; the stock of the circulating medium being increased and replenished by additions from the outside. The activities of animals and the processes of decomposition liberate the gas, which is taken up and manufactured by the plants into organic substances; and these in turn serve as food and as material for new decomposition; while from the air the water may be absorbing new supplies of carbon dioxide to make good the losses of this process. Thus under normal conditions, the lake would return little or no carbon dioxide to the atmosphere, but would utilize within itself all that it manufactured or absorbed, at least until the plant life became so abundant as to be limited by other causes than that of food supply.

If this were all, the story would be quite simple and quite to the advantage of the lake. But it is by no means all the story; on the other hand, so far from being forced to solve problems associated with an oversupply of carbon dioxide, the lake has to encounter many difficulties in securing an adequate supply of that gas, and is able to meet them only very partially and imperfectly. Since the plants are able to utilize carbon dioxide in the manufacture of starch only during the hours of sunlight, considerable quantities may escape into the atmosphere during the night. But this is not the only disadvantage as regards the supply of carbon dioxide, with which the plants of the upper water have to contend. By no means all, or even the greater part of the organic matter which they manufacture decomposes in the upper, warmer stratum of the lake. As the plants and animals die, they sink into the lower and cooler water before any great part of the decomposition has been completed. The carbon dioxide which is there produced is discharged into this bottom water. It cannot be used there by plants on account of lack of light; and the same imperfections of transportation which prevent the access of oxygen to the cooler water in summer make it impossible to transport the carbon dioxide produced there to the upper stratum, where it can be utilized. In certain lakes, indeed, a small portion of this gas may be used in the cooler water, as I indicated above, but, in general, the upper water, as a result of

this process, is growing poorer during the summer in the materials on which plants feed, both gaseous and other. These are for the time locked up in the lower water and so withdrawn from the circulation of life. In the autumn, as the lake cools and the thickness of the circulating stratum increases, these matters become available so far as they lie in the upper part of the cooler water, and when the lake has become uniform in temperature to the bottom, and the water is turned over by the wind, the whole of this accumulated stock is available for the purposes of plant growth. This may be one of the reasons for the abundant growth of algae, which takes place in the autumn. But while the non-gaseous products of decomposition may be wholly utilized in the lake, the carbon dioxide is hardly likely to find full use. When it once becomes distributed through the water and new portions of the water are being continually exposed to the air, considerable quantities must escape during the hours when plants are unable to avail themselves of it.

Thus the rudimentary character of the circulatory apparatus of the lake forms an insuperable obstacle to the best utilization of their food supply. It is therefore easy to see why life is relatively so abundant in large and shallow lakes, in which the circulating methods have a maximum efficiency. The fact that they are shallow permits a larger growth of life, since not only is the water available but plants in large quantities may grow from the bottom. But of even more importance than this relation is the fact that since the entire mass of water is kept in circulation by the wind, all of the products of decomposition are immediately available for use and the life cycles of the plants may go on as rapidly as their rhythm of growth will permit. The carbon dioxide and other products of decomposition, instead of being locked up in the deeper water and set free only during that season which is less favorable for growth, are utilized immediately and are employed over and over again through the warmer season as the cycles of life and death of the individual plants recur. It is plain that lakes whose margin is wide and shallow, though the middle may be deep, must stand next to the shallow lake in efficiency of means of transportation. Much growth takes place in shallow waters, much decomposition goes on there, and little of the organic matter sinks into the deep

water, to be withdrawn from circulation. Least favorably situated is the deep and steep-sided lake, whose cold depths are continually swallowing almost all of the products of the summer's growth, and give them back for use, only late in the autumn when the season for active life is passing away.

Some lakes may find aid from another source in the task of securing carbon dioxide. Most natural waters contain a certain amount of calcium and magnesium salts in solution, and, for the greater part, these exist in the form of bicarbonates. Lakes whose water is hard contain a considerable amount of these bicarbonates and soft-water lakes have little or none. In hard-water lakes it is found that during the growing season, when algae are active, the upper water contains no free carbon dioxide, but is, on the contrary, alkaline to indicators like phenolphthalein. This alkalinity comes from the fact that one molecule of carbon dioxide has been withdrawn from part of the bicarbonates converting them into carbonates. It appears that the algae are able to effect this reduction and that they can obtain their supply of carbon from the carbon dioxide of the bicarbonates dissolved in the water. This fact introduces a wholly new feature into the story of the food supply of the plants. It provides a chemical carrier for the carbon dioxide, which may carry this gas somewhat as the haemoglobin carries oxygen in the blood. All carbon dioxide set free in this alkaline water as the result of decomposition or other processes, will be taken up immediately by the carbonates. Thus if plants are not at hand to utilize the carbon dioxide at once, it is not lost but kept until it is needed. So in the night, the lake is able to retain all the carbon dioxide set free and which the plants do not use at that time.

Such alkaline water has also a great advantage in absorbing carbon dioxide from the air. It presents for absorption, not merely the relatively weak and slow powers of the water for dissolving the gas, but the eager and vigorous powers of chemical affinity. And until these alkaline carbonates are saturated, no free carbon dioxide will appear in the water to diminish the rapidity of absorption from the air. Thus hard-water lakes have an advantage over soft-water lakes in the matter of securing plant food, and in fact the population of soft-water lakes seems to be smaller than that of lakes of the other type.

It is worth while to devote a few words to gaseous products of decomposition other than carbon dioxide. So long as the bottom water contains an abundance of oxygen no other gas than carbon dioxide is produced in appreciable quantities. But as the oxygen becomes greatly reduced or wholly disappears, decomposition continues in new forms, and under these conditions of anaerobic fermentation other gases may be developed in considerable amount. It is apparently true that carbon monoxide may be present in the lower water of lakes in appreciable quantities, and it is certain that marsh gas is developed in large volumes in lakes where the amount of fermentable material is great and where the oxygen dissapears from the lower water early in the season. These gases first appear near the bottom, where decomposition is going on most actively and where oxygen first disappears. In many lakes they are found only in small quantities and close to the bottom, but in proportion as the amount of decomposable matter increases, they are found at considerable distances from the bottom, and in certain lakes all of the water below the thermocline may contain marsh gas in appreciable quantities, often becoming very great as the bottom is approached. These gases do not seem to have any very definite unfavorable effect on the life of the lake. Diffusion is so slow that they do not reach the upper water and experiments indicate that their presence in the lower water adds little, or nothing, to the unfavorable conditions brought about by the absence of oxygen.

It should be noted that these processes involve a loss of meterial for plant food. Carbon dioxide, produced by aerobic decomposition, is available for plant food in the lake, or, if not there, then elsewhere as part of the general stock of that gas in the atmosphere. But marsh gas has no such relation to plants and all substances converted into it are lost to the cycle of life. Its production means just so much reduction of the food supply of the lake. The same may be said of the carbonized, peat-like substances produced from the partial decomposition of plants under water. So long as these remain under water, they are practically withdrawn from the food supply. Against all these influences which tend to diminish the stock of food for its inhabitants, the lake is contending, but with imperfect means and only partial success.

I have thus hastily and imperfectly sketched the respiration of an inland lake, not because the story is known with any fullness or completeness, but partly because our present knowledge, imperfect though it is, shows that the subject is one of great scientific interest; partly also because many practical hints regarding the utilization of lakes in fish culture can come from our knowledge of respiratory conditions. We are accustomed to think of the food producing capacity of the lake as the factor which determines the kind and amount of the crop of fish which it can produce. It is a somewhat new thought to me, and I have no doubt that it is equally new to many of you that the respiratory capacity of the lake may have even greater influence in this matter than has the capacity for the production of food. Yet it is plain that such is the case and that a knowledge of the respiratory conditions of the lakes in which our fish are to be planted is necessary if the best results are to be reached.

DISCUSSION.

Mr. Titcomb: I just want to say one thing in connection with the question of "Respiration," and that is the use of the outlet of a lake as a water supply for fish culture purposes. Dr. Bean in his enumeration of a few of the troubles, mentioned the fact that it was difficult even in the state of New York to find suitable water supply. Now, I have always entertained the theory that to get an abundant supply of water for an immense trout hatchery, perhaps larger than any in existence, the outlet of a lake would be the proper source. Dr. Birge brings out again, as he did last year, some of the difficulties to be encountered. At the same time, I think that his investigations, or investigations along the same line, would definitely determine whether it is safe to use the outlet of a lake. In other words, in the summer time, we wish to get an abundance of cold water. Now, the question is, whether we can go to a lake and draw the water from a certain depth to get cold water, and at the same time get water containing the proper amount of oxygen. I infer from his paper, that it can be easily determined at what depth we can depend upon a certain temperature of water and at the same time determine whether the water at that depth contains sufficient

life to hatch and rear young fish. I think that is really a very valuable point to be considered in connection with this investigation.

President: That can very readily be determined. Of course if you are willing to take the surface water, that is all right.

Mr. Titcomb: That is usually too warm.

President: If you want the deeper water, you will have to consider several questions. If you want a very large supply, you will have to consider the question as to whether there is sufficient water in the lake to give you water of that temperature, because you will find that the supply of water in the lower part of the lake is in ordinary cases extremely small. We have done a great deal of work on lake temperatures, which I hope to have published during the year. Now, we find that there are very few lakes indeed where the bottom temperature during the winter rises to an appreciable extent in a way which can be attributed to ground water. This means that very little water is getting into the lake from the ground, since the lake temperature goes down to 2° or 3° C., and the temperature of the ground water in our latitude is somewhere about 8° C. Almost all water coming into the lake, comes in the upper part above the water level, or immediately below it, and the idea which so many people have that there are great springs down in the bottom of lakes is entirely erroneous. In an open sand region, where there is comparatively little clay near the lakes, there may be the same kind of slow circulation through that sand bottom that there is through the general water-bearing strata of the country, but in most lakes the bottom is covered with a very impermeable layer of mud. We were working on the winter temperatures of Lake Mendota last winter. We had a pipe about twelve feet long, and drove it down into the mud in sixty or seventy feet of water, so that we got a section of mud; we could not get more than five feet of mud to come up in the pipe; that was just as sticky as hasty pudding. There was practically no seepage of water through it; so that the entrance of water into the deeper part of the lake is slight. It you wanted a small supply for a hatching trough, that would be all right;—but if you wanted water on a large scale, to supply a trout hatchery in that way,

you would have to consider carefully whether the lake would stand that drain upon it, because by far the greatest source of water is at the surface and immediately below the surface.

If you will go to a lake in August or September, and determine the question of temperature and gas, which is a very easy thing to do, that will tell the story.

President: Is there anything further in this matter?

Mr. Seymour Bower: It is a very important paper and has a great deal of practical value. I think the planting of a great many of the fish which we are now planting might be avoided. We plant a good deal of lake trout by eggs.

President: I believe that if you are going into planting lake trout or whitefish in any inland lakes, it would pay you to have the lakes examined before you put the fish in; but I hope to be able to say that positively next year. Last year we did this, which shows you something about it. You know the black fin, which is the common whitefish of our inland lakes (*nigripennis*), it has been said goes to the bottom in summer. Now unless it goes into the mud like a frog in the winter, it cannot go down, because these lakes have no oxygen in the bottom water. We were working on one of the lakes in northern Wisconsin, a lake about fifty feet deep, and we happened to set our gill net right across this point in the lake where the cool water begins. The inner end was in the warm water, and the outer in the cool water, and when the net was taken up, there were perhaps eight or ten of these black fins, and they came from the lake just at this junction. Now it seemed to us that this showed, as well as one experiment could show, the fact that this fish was living in water which was just as cold as it could find oxygen in. So that there would be only a pretty limited area in that lake in which that fish could live.

Mr. Clark: On account of the temperature of the water—did that have something to do with it?

President: They would not come up in the warm water any more than was necessary. They probably liked the cold water. But they would go down into the cold water as far as they could.

They would not be shut out of the lower water by the temperature.

Mr. Clark: Mr. President, some years ago, I had just that same experience in making some investigations in a small lake in Oakland County, Michigan, in Walunt Lake, and that was in November, and the gill net was set not on shore, but in perhaps five or six feet of water, and run out several rods—I could not give you the distance; we caught thirty whitefish, six lake trout and one pike perch. The whitefish were in the net in not over twenty feet. They were bunched right in, and the lake trout were right just above them, and the one pike perch was above.

President: We had this experience with lake trout. We went to a lake in northern Wisconsin, known as Trout Lake, which I wrote of in the paper I published in the last transactions, although the lake was examined after the meeting. We set our net there in the deepest water, very close to a hundred feet, and after it had been set, we went out and determined the oxygen right down to the bottom of the water, and found oxygen there. On hauling the net at the same time, we found a number of lake trout in the net at that depth, so they were in the very bottom of the lake; as a matter of fact, they were in the bottom part of the net, though I do not suppose that had any special significance; they might have moved down as well as up; but they were in as deep and cold water as they could find.

Mr. Clark: That was the reason they were there, trying to find that cold water.

President: The net did not extend from warm to cold water. This was wholly into the deep water.

Mr. Carter: Is there any way to determine how much oxygen there is? Can you tell us?

President: We have used the Winkler method of testing for oxygen, if you know that.

Mr. Carter: I don't know anything about it at all.

President: I am ignorant of chemistry, yet I learned in half an hour to use the test, and think anybody else can. It is one of the standard methods in the books. We use a pump and

hose to bring the water up, which has to be mixed with various chemicals. When you come to the actual test the amount of the solution to be used varies with the amount of oxygen originally present in the water. The proper amount can be determined very accurately because the color of the water changes when enough of the solution has been added, and from the amount used it is easy to determine the amount of oxygen present.

Mr. Clark: I would like to ask the president if Professor Hawkinson has published his report.

President: Professor Hawkinson has not, at least I suppose not, I haven't received it.

Usually the lakes in Wisconsin which carry oxygen to the bottom have shown very sparse bottom life and from the reports I have received from Mr. Wagner, who is looking up the fish, that seems to be true in the additional lakes he has examined this season.

Mr. Lydell: Would it be possible for a practical fish culturist to take the apparatus and find out whether there was oxygen, without a scientist to tell him?

President: If I had the apparatus, I could show anybody how to use it.

Mr. Lydell: This paper was very interesting to me. Lots of times, while raising nets while on examination of state waters, we would find, as the net would drop off into deeper water, the fish would shut off instantly. Last season, the commission sent me to one of the lakes to find if there were any wall-eyed pike there. I had supposed the wall-eyed pike would be in deep water, but did not find any. I have found out now why I did not find them.

President: The only trouble with your investigation is that if you are going to do it, you must carry a pump and hose, a number of bottles and so on, and it is a good deal of a nuisance.

(A Voice: It depends on the bottle.)

President: These are a different kind of bottles.
(Laughter.)

THEORY vs. PRACTICAL TESTS

BY J. J. STRANAHAN, OF BULLOCHVILLE, GA.

It had not been my intention to prepare a paper for this meeting, but a little reflection has changed my mind.

I take it for granted that the question of large and small fingerlings in black bass planting is settled in favor of the latter, or rather in favor of both, but even if it is, a few words on this side of what was at one time a controversy, may prove interesting if not instructive.

The Cold Spring, Ga., station of the bureau of fisheries distributed during the fiscal year closing June 30th, 242,000 black bass, of which the major portion was what is known as No. 1 fingerlings, ranging in length from one inch to one and a half inches. This allowed us to cover well the states of Georgia, Alabama and South Carolina, with some shipments for North Carolina and Florida.

If an attempt had been made to supply these hundreds of applicants with large fingerlings, say two to four inches long, we must have signally failed. But it may be urged that the few served with the larger fingerlings would have been better served. This positively would not have been so, as shown by actual results. It will require from 500 to 1000 No. 1 fingerlings to produce 100 No. 3's, and the 500 or 1000 No. 1's will produce far greater and more satisfactory results than the 100 3's. From our past four years experience in planting No. 1's we get only favorable reports. In the neighborhood of the station where we have a better chance for observation, we get reports most gratifying. In the case of new ponds or those newly stocked, the owners bring us reports of the capture of one-year- old bass in greater numbers than it would have been possible to have planted if only large fingerlings had been distributed. From all directions came only favorable reports. Pond building and fish culture interests are greatly on the increase over all the territory that we cover, and there could be no better endorsement than

this of the plan of planting thousands of No. 1's in place of hundreds a little larger.

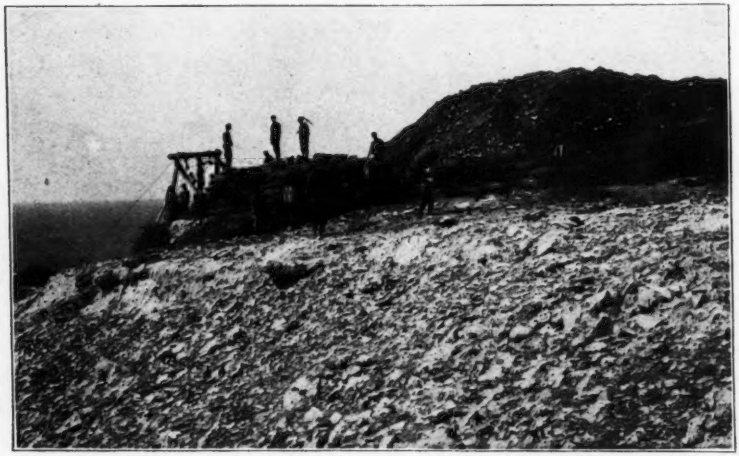
Our aim is to hold our young bass in the brood ponds just as long as possible and collect them before the school breaks up. This when they are from one to one and one-half inches long, perfectly formed in fin, scale and development and as hardy and easily transported even to long distances, as their larger brothers.

A STUDY OF THE GUANO INDUSTRY AND FISHERIES OF PERU

BY ROBERT E. COKER,

Of Johns Hopkins University, Baltimore, Md.

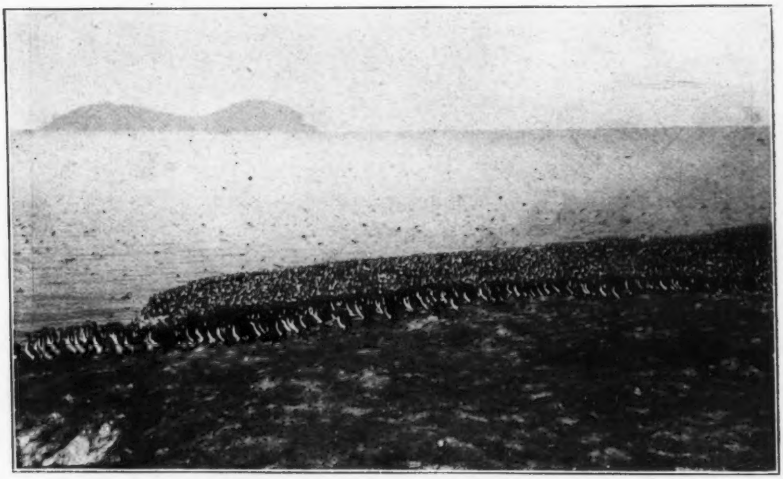
My object in Peru is to study the guano islands from the biological aspect, with reference to suggesting measures for the protection of the birds and the perpetuation of the guano in-



Shipping guano from S. Island of the Ballestas — altitude about 400 feet or more. The big pile of guano, being sacked, is all new — nests of cormorants made during past breeding season. Is being lowered to a "lancha" which conveys it to a German barge destined for Antwerp. June, 1907.

dustry. Also to make inquiries in regard to the fishes and fishery methods in Peru, with a view to recommendations looking to the development of the fishery industries of Peru. These may seem to be two quite distinct lines of work, yet there is a close relation between them and the Peruvian government has acted wisely in coupling the two studies together at the beginning. Not only is guano actually a fishery product, the birds serving as agents in the fishery, but in regulation and protective meas-

ures the only two classes of people to be considered are the guano workers and the fishermen, and the execution of such measures may efficiently and economically be vested in the same office which may direct the fisheries. In accordance with instructions from the Director de Fomento, I am visiting the most important coast points and the chief guano islands. In the northern region I have made a trip from Callao to Payta (a difference of 7° of latitude), visiting seven coast points and five groups of guano



Cormorants, the birds that make the guano on S- Is. of Ballestas. Only a small part of the flock is in view. June, 1907

islands. At shore points and islands notes are made in regard to the fishes observed and reported and the methods of fishery in use. At the islands attention is given to the abundance and habits of the birds and the relation of birds and lobos. I am now in the Ballestas islands off Pisco in the south and expect to visit in the near future, the Chinchos, San Gallan, the islands of Independencia Bay and such coast points as time allows for.

In addition to the inquires mentioned I am collecting fish, guano birds, and some other forms for subsequent systematic identification of the useful forms.

Fishery. The fisheries of Peru are capable of greater development. The markets of the coast are supplied with some excellent fresh fish but not to the degree, as regards number and variety of fish, to which they may be. The fish of Peruvian waters, in salted condition are appreciated by the inhabitants of Peru and neighboring countries, but the salting industry is

Shipping guano from Ballestas—height 200-300 feet. (Middle island). May, 1907

at present on a most unsatisfactory basis and of an importance far below its possibility.

Some of the methods in use are of interest. The cavallitos or "pony" boats are perhaps well known—a small and graceful boat of reeds on which the Indian fisherman rides astride, as on a hobby-horse, using his hook and lines or working his end of the seine—in most picturesque fashion. The balsas or rafts (large and small) of balsa wood are very serviceable and exclusively used in some regions. On the larger ones, with big sails spread, the fishermen take their families with them to remain out fishing and salting their catch for periods of a number of days. These primitive but useful types of boat are to a great extent displaced now by more modern fishing boats, especially Mediterranean types introduced by Italian and Greek fishermen.

It is interesting to find the selachians valued as food fish,—sharks, rays, angelotas (angel-fish), guitarras (guitar-fish). The guitarras and sometimes angelotas are dried by a process accomplished without the use of salt or other preservative material.

The only important shell-fish marketed is the scollop—crabs are almost unused; the spiny lobster is fished but on a small scale. The comparatively abundant green turtle is quite unappreciated, being scarcely used except for oil for medicinal purposes and for miners' lamps.

Guano. While the ancient deposits of guano are almost exhausted, the industry of the extraction of guano is not to be regarded as a matter of the past. Competent persons estimate the present annual deposit at 25,000 tons or more. I cannot now venture an estimate, but may say that the above estimate gives a fair idea of the present commercial importance to Peru of the guano birds, and I feel assured in stating from observations, that with proper regulation—effective protection of birds and eggs from destruction, observance of closed season, and probably alternate closing of islands, the present available annual deposit may be considerably increased.

By measurements, weights and computation, I have estimated the deposit on the chief breeding ground of this island as over 250 tons of pure guano. Guano extractors here now compute that upwards of 500 tons of *new* guano will be shipped from this island this season—and this is the least important of the three larger islands of this one group.

The important guano birds as so far observed, are in order cormoranta (3 species, one important), pelicans, gannets (2 species). Other interesting bird inhabitants of the island are Larus gulls (two species, one of possible injury to the industry), penguins, the "potiyunki" (a bird I have not taken yet)—the turkey buzzard (injurious in the destruction of eggs and young), and some shore birds. The only mammals I have observed are the lobos, and, in the caves, small bats.

THE NEED OF AN INTERNATIONAL FISHERIES SOCIETY

BY O. T. OLSEN, GRIMSBY, ENGLAND.

There is probably no one present who will hesitate to agree that there is an urgent necessity for the establishment of such a society as the one I now propose. Many congresses are held from time to time, and many matters of interest to the fishing industry are discussed, but unfortunately it is generally found that after the talking is done, and the resolutions are passed, matters deserving a better fate are allowed to drop for the want of a representative international society to make use of the information thus gained. If such a society were in existence, the best results of individual and collective effort might be utilized for the benefit of the fishing industries of the nations concerned. These industries have of recent years developed enormously. So much so that there are those to be found who assert that as a wealth-producing concern fishing has seen its best days. It is a well authenticated fact, however, that the depredations of trawlers are small in comparison with the damage done by the fish themselves. Individual scientists have done excellent work in the past, but it is only of recent years that international investigation has been attempted. Much very valuable research is being made at the present time, but for the full benefit to be enjoyed by the fishing industry, and indirectly by the general public, an international fisheries society is indispensable. It should consist of scientific and commercial men with one common object in view—that is, the well-being of fishing as a commercial undertaking, and its development as a means of providing food. In obtaining the best results commercially the work of the scientist plays a very important part. As time advances it will doubtless be found that this part becomes increasingly important, so that it behoves everyone interested, whether financially or otherwise, to support any proposal leading to the coöperation of science and commerce.

When formed, and in proper working order, such a society

would be in a position to make representations to any government, with a view to reform and introduction of measures calculated to further the interests of all. It would not only be able to make use of the results of the work of others, but it would be a capable and influential body in itself, holding meetings periodically and issuing literature. It should prosecute with energy the study of all matters pretaining to fish life before capture, and after capture to study the best means of converting it to the public use, at all times by means of its literature acquainting its members with its proceedings. To briefly summarise I would give a few heads which would be dealt with advantageously:—

(1.) The natural history of fishes; their use as human food, their migrations and habits.

(2.) The means of catching, preserving and transporting fish.

(3.) Oceanography; the physical condition of the sea; tidal effects; fish hatching.

(4.) Fishery laws; determining the nationality of fishing vessels at sea.

(5.) Fishing vessels and their appliances.

(6.) The qualifications of skippers and mates of fishing vessels, and their examination for certificate of competency.

(7.) Territorial limitations.

These headings, of course, could be extended indefinitely as requirements demanded. Fishing as a sport might be included with a view to the better accommodation of anglers in countries other than their own, working in conjunction with the clubs and societies already in existence for this purpose.

Such a society, with an influential and enthusiastic president, a council composed of men bent on the advancement of the fisheries, and a body of members eager to help one another (and incidentally to help themselves), cannot fail to accomplish its purpose. It would be supported by the subscriptions of its members, and issue its literature in English, French and German. The meetings could be held in several countries in rotation.

Further evidence of the demand for such a Society is not

lacking, and as time advances that demand increases. Perhaps in this audience may be found a few willing to be the nucleus from which the proposed society will be formed, and to whom the thanks of the Fisheries, and indirectly the thanks of the public, will be due.

(Applause.)

LIST OF MEMBERS

ACTIVE.

Ainsworth, C. E., *Sault St. Marie, Mich.*
Ainsworth, C. G., *U. S. B. F., Leadville, Col.*
Alford, Jabe, *29 W. Dayton Street, Madison Wis.*
Allen, G. R., *U. S. B. F., Spearfish, S. Dak.*
Alexander, A. B., *U. S. B. F., Washington, D. C.*
Alexander, George L., *Grayling, Mich.*
Alexander, L. D., *50 Broadway, New York.*
Anderson, J. F., *Bastad, Sweden.*
American Fish Culture Co., *Carolina, R. I.*
Annin, James, Jr., *Caledonia, N. Y.*
Atkins, Charles G., *U. S. B. F., East Orland, Me.*
Atwood, Anthony, *73 Waterest Street, Plymouth, Mass.*
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Ayer, F. W., *Bangor, Me.*

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Bassett, F. R., *Paw Paw, Mich.*
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Bean, Hon. Tarleton H., *Capitol, Albany, N. Y.*
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Belmont, Hon. Perry, *580 Fifth Avenue, New York City.*
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Bispham, Charles K., *1508 Walnut Street, Philadelphia, Pa.*
Bissell, John H., *Detroit, Mich.*
Blatchford, E. W., *Chicago, Ill.*
Blakeslee, T. J., *353 Fifth Avenue, New York City.*
Boardman, W. H., *Central Falls, R. I.*
Bogle, C. M., *Editor Pacific Fisherman, Seattle, Wash.*
Booth, Dewitt C., *U. S. B. F., Spearfish, S. D.*
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Buller, Nathan R., *Pleasant Mount, Pa.* (Life.)
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Bumpus, Dr. H. C., *American Museum of Natural History, 77th and 8th Avenue, New York City.*
Burkhaus, Jerry, *Holmesburg, Pa.*

Burner, W. G., *Durbin, W. Va.*
Burrowes, John C., *Norfolk, Va.*

Campbell, S. H., *State Fish Commission, Laramie, Wyo.*
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Chandler, Horatio, *Kingston, Mass.*
Cheney, Major Richard O., *South Manchester, Conn.*
Cheyney, John K., *Tarpon Springs, Fla.*
Clark, C. C., *316 East South Street, South Bend, Ind.*
Clark, Frank N., *U. S. B. F., Northville, Mich.*
Clark, Fred, *Mill Creek, Mich.*
Clark, Walton F., *Westerly, R. I.*
Cobb, E. W., *Taunton, Mass.*
Cobb, John N., *U. S. B. F., Washington, D. C.*
Cogswell, T. M., *U. S. B. F., Washington, D. C.*
Cohen, N. H., *Urbana, Ill.*
Coker, Robert E., *Johns Hopkins University, Baltimore, Md.*
Cole, Leon J., *186 Lawrence Street, New Haven, Conn.*
Cone, Moses H., *Greensboro, N. C.*
Conway, R. J., *Belle Isle, Detroit, Mich.*
Cooper, E. A., *Cold Spring Harbor, L. I.*
Corliss, C. G., *U. S. B. F., Gloucester, Mass.* (Life.)
Cox, Hon. Henry C., *Wellsboro, Pa.*
Cruickshank, James, *275 Central Park, West, New York City.* (Life.)
Cunningham, F. W., *U. S. B. F., Gloucester, Mass.*
Curry, E. J., *Freeland, Pa.*
Curtis, J. M., *Cleveland, O.*
Cutler, Wm., *Mill Creek, Mich.*

Davies, David, *Wytheville, Va.*
Dean, Herbert D., *U. S. B. F., Neosho, Mo.*
Degler, F. A., *Sportsman's Association of Cheat Mountain, Cheat Bridge, W. Va.*

Delaney, O. J., *Moorestown, N. J.*
Dennis, Oregon Milton, *Secretary Maryland State Game and Fish Protective Association, Baltimore, Md.*
DeNyse, Washington J., *Gravesend Beach, Borough of Brooklyn, N. Y.*
De Puy, Henry F., *466 Dunham Ave., Cleveland, Ohio.*
Dickerson, Freeman B., *Detroit, Mich.*
Dickinson, G. C., *Harrietta, Mich.*
Dinsmore, A. H., *U. S. B. F., Birdsview, Wash.*
Donahue, L. H., *Leadville, Col.*
Douglas, W. B., *St. Paul, Minn.*
Downing, S. W., *U. S. B. F., Put-in-Bay, O.*
Dunlap, I. H., *U. S. B. F., Washington, D. C.*

Evans, A. Kelly, *25 Front St., Toronto, Can.*
Ebell, Hon. F. W., *Harrisburg, Pa.*
Edwards, Vinal N., *U. S. B. F., Woods Hole, Mass.*
Ellis, J. Frank, *U. S. B. F., Washington, D. C.*
Evans, Barton D., *Harrisburg, Pa.*
Evermann, Prof. Barton W., *U. S. B. F., Washington, D. C.*
Evermann, J. W., *Assistant General Manager Texas & Pacific Railroad, Dallas, Tex.*

Fassett, H. C., *U. S. B. F., Washington, D. C.*
Fearing, Hon. D. B., *Newport, R. I.* (Life.)
Ferry, C. H., *Room 1720, Old Colony Building, Chicago, Ill.*
Filkins, B. G., *Northville, Mich.*
Fisher, John F., *Chapinville, Conn.*
Follett, Richard E., *New England Fish and Game Protective Association, Boston, Mass.*
Fox, Captain J. C., *Put-in-Bay, Ohio.*
Fullerton, Samuel F., *St. Paul, Minn.*

Gardner, W. E., *Hollidaysburg, Pa.*
Gavitt, W. S., *Lyons, N. Y.*
Geer, Dr. E. F., *St. Paul, Minn.*
Geer, E. H., *Hadlyme, Conn.*
Gibbs, Charles, *U. S. B. F., East Orland, Me.*
Gill, Dr. Theodore, *Smithsonian Institute, Washington, D. C.*

Goldsborough, E. L., *U. S. B. F., Washington, D. C.*
Graham, A. R., *Berkeley, Mass.*
Grant, R. P., *Treasurer Anglers' Association of St. Lawrence River, Clayton, N. Y.*
Grave, Dr. Caswell, *Johns Hopkins University, Baltimore, Md.*
Gray, George M., *Woods Hole, Mass.*
Green, Chester K., *U. S. B. F., Cape Vincent, N. Y.*
Green, Dr. D. W., *Ohio Fish and Game Commission, Dayton, O.*
Grill, John H., *Sherburne, Minn.*
Grindle, C. S., *U. S. B. F., East Orland, Me.*
Gunckel, John E., *Toledo, O.*
Gurinian, V. G., *248 Jackson Boulevard, Chicago, Ill.*

Haas, William, *Corry, Pa.* (Life.)
Hagert, Edwin, *The Continental, Philadelphia, Pa.*
Hahn, Captain E. E., *U. S. B. F., Boothbay Harbor, Me.*
Haley, Caleb, *Fulton Market, New York.*
Hall, C. E., *Superintendent Parkside Hatchery, Criesco, Pa.*
Handy, L. B., *South Wareham, Mass.*
Hankinson, T. L., *Charleston, Ill.*
Hanson, G., *Osceola Mills, Wis.*
Harron, L. G., *U. S. B. F., Washington, D. C.*
Hartley, R. M., *560 Bullitt Bldg., Philadelphia, Pa.*
Hartman, Phil., *Erie, Pa.*
Hay, Prof. W. P., *Howard University, Washington, D. C.*
Hayes, J. R., Esq., *Detroit, Mich.*
Hamberger, Hon. John, *Erie, Pa.*
Helmer, D. S., *Post Allegheny, Pa.*
Helmer, E. R., *Post Allegheny, Pa.*
Hempshill, T. J., *Hollidaysburg, Pa.*
Henkel, C. D., *Tupelo, Miss.*
Henkel, C. P., *U. S. B. F., Afognak, Alaska.*
Henry, W. S., *Parkside, Pa.*
Henshall, Dr. James A., *U. S. B. F., Bozeman, Mont.*
Hill, J. H., *Superintendent Umpqua Hatchery, Hoaglin, Douglas County, Ore.*
Hines, W. B., *White Sulphur Springs, W. Va.*
Hobart, T. D., *Pampa, Gray County, Texas.*
Hogan, J. J., *Madison, Wis.* (Life.)

Holden, H. S., *Syracuse, N. Y.*
Hubbard, Waldo F., *U. S. B. F., Nashua, N. H.*
Hughes, Hon. W. H., *St. Louis, Mo.*
Hume, R. D., *322 Merchants Exchange, San Francisco, Cal.*
Huntington, L. D., *New Rochelle, N. Y.*
Hurlbut, H. F., *East Freetown, Mass.*
Hutchinson, E. S., *1331 G Street, Washington, D. C.*

Ingraham, E. W., *Oil City, Pa.*
Irish, Clifford E., *Lake George, N. Y.*

Jennings, G. E., *Fishing Gazette, 203 Broadway, New York City.*
Jewett, Stephen S., *614 Main Street, Laconia, N. H.*
Johnson, F. M., M. D., *43 Tremont Street, Boston, Mass.*
Johnson, O. J., *Glenwood, Minn.*
Johnson, Mrs. F. M., *43 Tremont Street, Boston, Mass.*
Johnson, R. S., *U. S. B. F., Manchester, Ia.*
Johnston, S. M., *Union Wharf, Boston, Mass.*
Jones, Dr. O. L., *33 W. 30th Street, New York.*
Joslyn, Hon. C. D., *Detroit, Mich.*

Keeseeker, A. G., *U. S. B. F., Fishery, Tenn.*
Kelly, H. L., Jr., *U. S. B. F., Oregon City, Ore.*
Kendall, Dr. William C., *U. S. B. F., Washington, D. C.*
Kent, Edwin C., *Tuxedo Club, Tuxedo, N. Y.*
Kenyon, A. W., *Usquepaugh, R. I.*
Kiel, W. M., *Tuxedo Park, N. Y.*
Kisterbock, Josiah, Jr., *"The Continental," Philadelphia, Pa.*
Kittredge, Benjamin R., *Kent Cliffs, Putnam County, N. Y.*
Knight, Prof. A. P., *Queens University, Kingston, Can.*

Lambert, E. C., *Amoskeag Mfg. Co., Manchester, N. H.*
Lambson, G. H., *U. S. B. F., Baird, Cal.*
Latchford, Hon. F. R., *Toronto, Can.*
Laumen, Felix, *U. S. B. F., Washington, D. C.*
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Leary, John L., *U. S. B. F., San Marcos, Tex.*
Leisenring, W. A., *Mauch Chunk, Pa.*

Lewis, C. C., *Northville, Mich.*
Lewis, Charles E., *Chamber of Commerce, Minneapolis, Minn.*
Locher, Wm. *Kalamazoo, Mich.*
Locke, E. F., *U. S. B. F., Woods Hole, Mass.*
Lydell, Dwight, *Mill Creek, Mich.*

Mahone, A. H., *Morgantown, W. Va.*
Mallory, Charles, *Burling Slip, New York.*
Manning, W. W., *P. O. Box, 1778, Boston, Mass.*
Manton, Dr. W. P., *Detroit, Mich.*
Marty, John M., *Minn. F. & G. Ass., St. Paul, Minn.*
Marks, H. H., *Sault St. Marie, Mich.*
Marks, J. P., *Paris, Mich.*
Marsh, M. C., *U. S. B. F., Washington, D. C.*
Martin, Timothy J., *care of Davis, Collamore & Co., Fifth Avenue, New York City.*
Mathewson, G. T., *Thompsonville, Conn.*
May, W. L., *1655 Market Street, Denver, Col.*
Mayhall, L. E., *Supt. Commercial Trout Co., Sultan, Wash.*
McCook, George M., *Ohio Fish and Game Commission, Steubenville, O.*
McDougal, J. M., *Gunnison, Col.*
Mead, Prof. A. D., *Brown University, Providence, R. I.*
Meehan, W. E., *Commissioner of Fisheries, Harrisburg, Pa.* (Life.)
Meeker, D. W., *Moorehead, Minn.*
Merrill, M. E., *U. S. B. F., St. Johnsbury, Vt.*
Miller, Frank, *Put-in-Bay, O.*
Milligan, Dr. J. D., *U. S. B. F., Woods Hole, Mass.*
Mills, G. T., *Carson City, Nev.*
Monroe, Otis, *Mill Creek, Mich.*
Monroe, William, *Mill Creek, Mich.*
Moore, Charles H., *care of Michigan Fish Commission, Detroit. Mich.*
Moore, Dr. H. F., *U. S. B. F., Washington, D. C.*
Morcher, George, *London, O.*
Morgan, C. W., *N. Y. Aquarium, New York.*
Morgan, H. A., *University of Tennessee, Knoxville, Tenn.*
Morrell, Daniel, *Hartford, Conn.*

Morris, Robert T., M. D., *616 Madison Avenue, New York City.*
Morton, W. P., *Providence, R. I.*
Mountain Lake Camp, *R. F. D. No. 1, Sanbornville, N. H.*
Mussey, George D., *Detroit, Mich.*

Neal, John R., *22½ "T" Wharf, Boston, Mass.*
Neal, L. J., *Mill Creek, Mich.*
Nevin, James, *Madison, Wis.*
Newman, Edwin A., *4305 8th Street, N. W., Washington, D. C.*
Norris, J. Olney, *Room 212, Chamber of Commerce Bldg., Baltimore, Md.*
North, Paul, *Ohio Fish and Game Commission, Cleveland, O.*

O'Brien, W. J., *South Bend, Neb.*
Ohage, Dr. Justus, *St. Paul, Minn.*
O'Malley, Henry, *U. S. B. F., Oregon City, Oregon.*
Orahood, H. M., *1010 Seventeenth Street, Denver, Col.*
Orr, W. J., *Bay Port, Mich.*

Palmer, Dr. Theodore S., *United States Department of Agriculture, Washington, D. C.*
Palmer, Stephen S., *Monticello, N. Y.*
Parker, W. H., *Lac la Peche, Quebec, Canada.*
Payne, Charles, *Wichita, Kans.*
Parkhurst, Hon. C. Frank, *Providence, R. I.*
Partridge, H. E., *Minneapolis, Minn.*
Paxton, Thomas B., *Ohio Fish and Game Commission, Cincinnati, O.*
Peabody, George F., *Appleton, Wis.*
Pennington, Robert, *Wilmington, Del.*
Peoples, Hon. Hiram, *New Providence, Pa.*
Pearce, Captain T. C., *U. S. B. F., Washington, D. C.*
Pope, T. E. B., *U. S. B. F., Washington, D. C.*
Porter, Hon. Richard, *St. Louis, Mo.*
Powell, W. L., *Harrisburg, Pa.*
Prather, J. Hub, *Lexington, Ky.*
Pratt, Joseph Hyde, *State Geologist, Chapel Hill, N. C.*
Preston, Hon. John L., *Port Huron, Mich.*
Price, Andrew, *Marlinton, W. Va.*

Price, Calvin W., *Marlinton, W. Va.*
Proctor, Hon. Redfield, *Proctor, Vt.*

Race, E. E., *U. S. B. F., Green Lake, Me.*
Ramsdale, Frank C., *Bayfield, Wis.*
Randall, G. W., *Plympton, Mass.*
Rankin, J. F., *Ohio Fish and Game Commission, South Charleston, O.*
Rathbun, Richard, *Smithsonian Institute, Washington, D. C.*
Ravenel, W. DeC., *Smithsonian Institute, Washington, D. C.*
Reed, C. A., *Fish and Game Warden, Santa Cruz, Santa Cruz County, Cal.*
Reighard, Prof. Jacob E., *University of Michigan, Ann Arbor, Mich.*
Richards, G. H., *Sears Building, Boston, Mass.*
Rippel, Robert, *Woodruff, Wis.*
Roberts, A. D., *Woonsocket, R. I.*
Roberts, C. C., *Woonsocket, R. I.*
Robinson, Robert K., *U. S. B. F., White Sulphur Springs, W. Va.*
Rogers, J. M., *159 La Salle Street, Chicago, Ill.*
Root, Henry T., *Providence, R. I.*
Rosenberg, Albert, *Kalamazoo, Mich.*
Ruge, John G., *Apalachicola, Fla.*
Russell, Henry, *Detroit, Mich.*

Safford, W. H., *Department of Fisheries, Harrisburg, Pa.* (Life.)
Salmons, Alden, *South Norwalk, Conn.*
Saunders, A. A., *Carolina, R. I.*
Saunders, Dr. H. G., *Chattanooga, Tenn.*
Seagle, George A., *U. S. B. F., Wytheville, Va.*
Sellers, M. G., *1306 Arch Street, Philadelphia, Pa.*
Sherwin, H. A., *100 Canal Street, Cleveland, O.*
Sherwood, George H., *American Museum of Natural History, 77th and 8th Avenue, New York City.*
Shireman, Eugene G., *Martinsville, Ind.*
Shortal, Hon. J. M., *906 Chestnut Street, St. Louis, Mo.*

Shurtleff, Merrill, *Fish and Game Commission of New Hampshire, Lancaster, N. H.*
Simmons, Walter C., *Providence, R. I.*
Singleton, James H., *Woonsocket, R. I.*
Slade, George P., *309 Broadway, P. O. Box 283, New York City.*
Smith, Frank W., *Superintendent Coos River Hatchery, Marshfield, Ore.*
Smith, H. G., *Minneapolis, Minn.*
Smith, Lewis H., *Algoma, Ia.*
Smith, Dr. Hugh M., *U. S. B. F., Washington, D. C.*
Smith, Captain J. A., *13 West 25th Street, Baltimore, Md.*
Snyder, J. P., *U. S. B. F., Washington, D. C.*
Southwick, J. M. K., *Newport, R. I.*
Spencer, L. B., *Superintendent Aquarium, 37 West 128th Street. New York City.*
Spensley, Calvert, *Mineral Point, Wis.*
Stapleton, M. F., *U. S. B. F., Mammoth Spring, Ark.*
Starbuck, Alexander, *Cincinnati, O.*
Starr, W. J., *Eau Claire, Wis.*
Steele, G. F., *Port Edward, Wood County, Wis.*
Stephens, Lawrence de K., *221 Drummond St., Montreal, Can.*
Stevens, Arthur F., *227 West Grand Street, Elizabeth, N. J.*
Stevenson, Charles H., *U. S. B. F., Washington, D. C.*
Stewart, A. T., *U. S. B. F., Northville, Mich.*
Stone, Livingston, *Cape Vincent, N. Y.*
Story, John A., *East Orland, Me.*
Stotz, Martin, *996 N. Marshall Street, Crogin Bldg., Philadelphia, Pa.*
Stranahan, J. J., *U. S. B. F., Bullochville, Ga.*
Stranahan, F. A., *Cleveland, O.*
Streeter, H. R., *Carolina, R. I.*
Sumner, Dr. Francis B., *College of the City of New York, New York City.*
Surber, Thaddeus, *U. S. B. F., White Sulphur Springs, W. Va.*
Sykes, Arthur, *Madison, Wis.*
Sykes, Henry, *Bayfield, Wis.*

Talbot, Henry, *Interstate Commerce Association, Washington, D. C.*

Tankersley, A. S., *Tupelo, Miss.*
Taylor, Robert Kirby, *Westfield, N. J.*
Teal, J. N., *Worcester Block, Portland, Ore.*
Thayer, W. W., *234 Joseph Campau Avenue, Detroit, Mich.*
Thomas, Henry G., *Stowe, Vt.*
Thomas, W. H., *Put in Bay, O.*
Thompson, George B., *Davis, W. Va.*
Thompson, James F., *Martinsburg, W. Va.*
Thompson, William H., *Secretary Anglers' Association of St. Lawrence River, Alexander Bay, N. Y.*
Thompson, W. P., *112 Broad Street, Philadelphia, Pa.*
Thompson, W. T., *U. S. B. F., Leadville, Col.*
Tinker, Eugene, *Corry Hatchery, Correy, Pa.*
Tinker, E. F., *St. Johnsbury, Vt.*
Titcomb, John W., *U. S. B. F., Washington, D. C.*
Townsend, A. A., *Carolina, R. I.*
Townsend, Charles H., *New York Aquarium, New York City.*
Tubbs, Frank A., *U. S. B. F., Neosho, Mo.*
Tulian, Eugene A., *Oficina, Meteorologica, 640 Viamonte, Buenos Ayres, Argentina.*

VanDusen, H. G., *Master Fish Warden of Oregon, Astoria, Ore.*
Venn, Harry S., *Washington, D. C.*
Vincent, W. S., *U. S. B. F., Tupelo, Miss.*
Vogelsang, Alexander T., *Mills Building, San Francisco, Cal.*
Von Bayer, Hector, *U. S. B. F., Washington, D. C.*
Von Lengerke, J., *318 Broadway, New York City.*

Waddell, John, *Grand Rapids, Mich.*
Walker, Bryant, *Detroit, Mich.*
Wallich, Claudius, *U. S. B. F., Afognak, Alaska.*
Walters, Chas. A., *Oxford & Mervine Streets, Philadelphia, Pa.*
Ward, Prof. H. B., *Lincoln, Neb.*
Waterhouse, Rev. E. M., *Broadway and 71st Street, New York City.*
Webb, W. Seward, *44th Street and Vanderbilt Avenue, New York City.*
Webb, W. M., *State Oyster Commissioner, Morehead City, N. C.*
Wentworth, E. E., *U. S. B. F., Baker, Wash.*

Wheeler, Charles Stetson, *2413 Washington Street, San Francisco, Cal.*
Whipple, Hon. Jas. S., *Capitol, Albany, N. Y.*
Whish, John D., *Secretary of Forest, Fish and Game Commission, Albany, N. Y.*
White, R. Tyson, *320 Bridge Street, Brooklyn, N. Y.*
Whitaker, Hon. Andrew R., *Phoenixville, Pa.*
Wilbur, H. O., *235 Third Street, Philadelphia, Pa.*
Willard, Charles W., *Westerly, R. I.*
Wilson, C. H., *Glens Falls, N. Y.*
Winn, Dennis, *U. S. B. F., Washington, D. C.*
Winn, S., *Carolina, R. I.*
Wires, S. P., *Lester Park, Duluth, Minn.*
Wolf, Herman T., *489 The Bourse, Philadelphia, Pa.*
Wolters, Chas. A., *Oxford & Marvine Streets, Philadelphia, Pa.*
Wood, C. C., *Plymouth, Mass.*
Worth, S. G., *U. S. B. F., Beaufort, N. C.*

Young, Capt. John L., *Atlantic City, N. J.*

Zacharie, Col. F. C., *345 Corondelet Street, New Orleans, La.*
Zalsman, P. G., *Paris, Mich.*
Zweighaft, S., *Deer Park, Haines Falls, N. Y.*

HONORARY.

Adams, Mr. Fred J., *Grand Rapids, Mich.*
Besana, Mr. Guiseppe, *President Lombardy Fishery Society, Via Torino 51, Milan, Italy.*
Borodine, Nicholas, *Chief Specialist in Fish Culture, Department of Agriculture, St. Petersburg, Russia.*
Cortelyou, Hon. George B., *Washington, D. C.*
Denbigh, Lord, *Colonel of the Honorable Artillery Company, London, England.*
Fish Protective Association of Eastern Pennsylvania, *1020 Arch Street, Philadelphia, Pa.*
Fryer, Charles E., *Supervising Inspector of Fisheries, Board of Agriculture and Fisheries, 3 Delahay St., London, England.*

Hamilton, Dr. J. Lawrence, *M. R. C. S., 30 Sussex Square, Brighton, England.*

Hoek, Prof. P. P. C., *Scientific Fishery Adviser of the Dutch Government, The Hague, Holland.*

Hofer, Prof. Dr. Bruno, *Munich, Germany.*

Johnson, Mrs. Frank M., *Boston, Mass.*

Kishinouye, Dr. K., *Imperial Fisheries Bureau, Tokyo, Japan.*

Lake St. Clair Shooting and Fishing Club, *Detroit, Mich.*

Matsubara, Prof. S., *President Imperial Fisheries Institute, Tokyo, Japan.*

Metcalf, Victor H., *Secretary of the Department of Commerce and Labor, Washington, D. C.*

New York Association for the Protection of Fish and Game, *New York City.*

Peck, Hon. George W., *Milwaukee, Wis.*

Perrier, Prof. Edmond, *Director National Museum of Natural History, Paris, France.*

South Side Sportsmen's Club, *Oakdale, L. I., N. Y.*

Steindachner, Prof. Dr. Franz, *Royal Natural History Museum, Vienna, Austria.*

The Governors of the Several States.

The President of the United States.

Vinciguerra, Dr. Decio, *Director Royal Fish Cultural Station and Aquarium, Rome, Italy.*

Von Grimm, Dr. Oscar, *Inspector-General of Fisheries, St. Petersburg, Russia.*

Von Pirko, Mr. Franz, *President Austrian Fishery Society, Vienna, Austria.*

Woodmount Rod and Gun Club, *Washington, D. C.*

CORRESPONDING.

Ayson, Lake F., *Wellington, New Zealand.*

Ayson, Charles L., *Hakataemen, Oamaru, New Zealand.*

Apostolides, Prof. Nicoly Chr., *Athens, Greece.*

Armistead, J. J., *Dumfries, Scotland.*

Birbeck, Edward, Esq., *M. P., London, England.*

Calderwood, W. L., Esq., *Inspector of Salmon Fisheries, Edinburgh, Scotland.*

Feilding, J. B., *Upper Downing, Holywell, North Wales.*
Giglioli, Prof. Enrico H., *Florence, Italy.*
Jaffe, S., *Osnabruck, Germany.*
Landmark, A., *Inspector of Norwegian Fresh Water Fisheries, Christiana, Norway.*
Marston, R. B., Esq., *Editor of the Fishing Gazette, London, England.*
Olsen, O. T., *Grimsby, England.*
Raveret-Wattel C., *Director of Agricultural Station at Nid-de-Verdier, 20 Rue des Acacias, Paris.*
Sars, Prof. G. O., *Christiania, Norway.*
Solsky, Baron N. de, *Director of the Imperial Agricultural Museum, St. Petersburg, Russia.*
Trybom, Dr. Filip, *Stockholm, Sweden.*

RECAPITULATION.

Active	382
Honorary	71
Corresponding	16
Total Membership	469

CONSTITUTION

(As amended to date.)

ARTICLE I.

NAME AND OBJECT.

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II.

MEMBERS.

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this society. In case members do not pay their fees, which shall be two dollars per year, after the first year and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues.

ARTICLE III.

OFFICERS.

The officers of this Society shall be a President and a Vice President, who shall be ineligible for election to the same office

until a year after the expiration of their term; a Corresponding Secretary, a Recording Secretary, a Treasurer and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV.

MEETINGS.

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting or, in default of such action, by the Executive Committee.

ARTICLE V.

ORDER OF BUSINESS.

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Standing Committees.
5. Committees appointed by the President.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
6. Reading of papers and discussion of same.
    (Note—a. In the reading of papers preference shall be given to the members present.
    b. The President and two Secretaries are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI.

CHANGING THE CONSTITUTION.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting provided at least fifteen members are present at said meeting.